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DS, GS, AND DEPOT MAINTENANCE MANUAL

RECEIVER, RADIO R-1547/FSQ-75(V)

HEADQUARTERS, DEPARTMENT OF THE ARMY

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WARNING

DEATH or SERIOUS INJURY may result from hazards in this equipment unless proper safety measures are observed when operating and maintaining the equipment. In addition to the 115-volt ac power supply circuits, B+ supply voltage of approximately 250v dc exists in the receiver when it is energized.

TECHNICAL MANUAL

No. 11–5820–735–35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *3 April 1969*

DS, GS, and Depot Maintenance Manual
RECEIVER, RADIO R–1547/FSQ–75(V)

		Paragraph	Page
CHAPTER 1.	INTRODUCTION		
	Scope	1–1	1–1
	Indexes of publications	1–2	1–1
	Reporting of equipment manual improvements	1–3	1–1
CHAPTER 2.	FUNCTIONING OF RECEIVER, RADIO R–1547/FSQ–75(V)		
Section I.	Block Diagram Analysis		
	General	2–1	2–1
	Functional receiver operation	2–2	2–1
II.	Schematic Diagram Analysis		
	General	2–3	2–2
	First and second RF amplifiers	2–4	2–2
	Third RF amplifier	2–5	2–3
	First oscillator and tripler	2–6	2–3
	First amplifier, second tripler, and second amplifier	2–7	2–3
	First mixer	2–8	2–3
	Second oscillator	2–9	2–3
	Second mixer	2–10	2–4
	IF Amplifiers	2–11	2–4
	Second detector and noise limiter	2–12	2–4
	First audio amplifier and squelch circuit	2–13	2–4
	Second audio amplifier and power output	2–14	2–6
	Automatic volume control	2–15	2–6
	Power supply	2–16	2–7
CHAPTER 3.	DIRECT SUPPORT MAINTENANCE		
Section I.	General		
	Scope of direct support maintenance	3–1	3–1
	Tools, test equipment, and materials required for direct support maintenance	3–2	3–1
II.	Direct Support Troubleshooting		
	General instructions	3–3	3–1
	Organization of troubleshooting procedures	3–4	3–1
	General precautions	3–5	3–2
	Troubleshooting procedures	3–6	3–2
	Visual inspection	3–7	3–2
	Checking power input, filament, and B+ circuits	3–8	3–3
	Operational test	3–9	3–4
	Signal substitution tests	3–10	3–7
	Voltage and resistance checks	3–11	3–11
	Troubleshooting chart	3–12	3–11
III.	Alignment and Adjustment		
	General	3–13	3–14
	Alignment of IF section, avc circuit, and second oscillator	3–14	3–14
	Alignment of first oscillator section	3–15	3–14
	RF alignment	3–16	3–15
IV.	Repair, Removal, and Replacement		
	General	3–17	3–17
	Installation of crystal Y501	3–18	3–17
	Removal and replacement of receiver dust cover	3–19	3–18
	Replacement of tubes	3–20	3–18
	Replacement of parts other than tubes	3–21	3–19
	Replacement of parts in the RF and oscillator subassemblies	3–22	3–19

		Paragraph	Page
	Removal of RF and oscillator subassemblies	3-23	3-19
	Repair	3-24	3-20
	Retropicalization after repairs	3-25	3-20
Section V.	Direct Support Testing Procedures		
	General	3-26	3-30
	Physical test and inspection	3-27	3-31
	Sensitivity test	3-28	3-32
	Squelch threshold	3-29	3-33
	Avc threshold and level control	3-30	3-34
	Maximum power output	3-31	3-35
	Selectivity and image rejection tests	3-32	3-35
	Audio frequency response test	3-33	3-40
	First and second oscillator frequency test	3-34	3-43
	Summary of performance standards	3-35	3-44
CHAPTER 4.	GENERAL SUPPORT AND DEPOT MAINTENANCE		4-1
5.	DEPOT OVERHAUL STANDARDS		
	Scope and applicability of depot overhaul standards	5-1	5-1
	Applicable references	5-2	5-1
	General test requirements	5-3	5-1
	Specific tests	5-4	5-1
APPENDIX A.	REFERENCES		A-1

CHAPTER 1

INTRODUCTION

1-1. Scope

a. This manual covers direct support, general support, and depot maintenance of Receiver, Radio R-1547/FSQ-75(V). It includes instructions appropriate to direct and general support and depot categories for troubleshooting, testing, aligning, and repairing the equipment. Detailed functioning of the receiver is covered in chapter 2. This manual also lists tools, materials, and test equipment required for maintenance.

b. Operating instructions and organizational maintenance for this equipment are contained in TM 11-5820-735-12.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new additions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are any modification work orders (MWO's) pertaining to the equipment.

Note. Applicable forms and records are covered in TM 11-5820-735-12.

1-3. Reporting of Equipment Manual Improvements

Reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be subsubmitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-ME-NMP-AD, Fort Monmouth, N. J., 07703.

CHAPTER 2

FUNCTIONING OF RECEIVER, RADIO R-1547/FSQ-75(V)

Section I. BLOCK DIAGRAM ANALYSIS

2-1. General

a. The purpose and operation of the various circuits in the equipment are explained in this chapter. Familiarity with the equipment, how it works, and why it works that way are valuable tools in troubleshooting the equipment rapidly and effectively.

b. This section furnishes a functional block diagram description of the receiver. A schematic diagram analysis of the equipment is furnished in section II.

2-2. Functional Receiver Operation

a. General.

(1) The receiver is normally used for reception of air-to-ground radio transmission signals in the range of 225 to 399.9 MHz, and can receive either voice or tone amplitude-modulated (am.) signals. It is designed for fixed frequency reception of a single channel. However, it is a dual superheterodyne receiver which uses two crystal controlled oscillators to produce two intermediate frequencies (IF) and can be tuned to individual channels spaced 100 kHz apart over its operating range. Tuning to a specific channel is accomplished by changing the first oscillator crystal and retuning the RF and oscillator stages.

(2) The first oscillator crystal is a CR-32/U type and is operated in a thermostatically controlled crystal oven to reduce frequency drift. Crystal frequency is determined as follows:
Crystal frequency (in MHz) 1/9 (desired channel frequency (in MHz) -40.4 MHz).

(3) The receiver will provide a minimum of one watt of audio output power when terminated across a 600-ohm load and receiving a 50-microvolt signal modulated 30 percent on all frequencies between 400 and 3,000 Hz.

b. Block Diagram Functional Operation.

(1) Figure 2-1 is an overall block diagram of the receiver. Input signals from the antenna are routed through three RF amplifier stages to the first mixer. Each RF stage has a tuned input and output circuit. A second input is applied to the first mixer from the first oscillator section. This input is the amplified output of a crystal-controlled oscillator multiplied by 9. The frequency is equal to the tuned channel frequency minus 40.4 MHz (the first IF frequency). The RF signal from the RF amplifiers and the first local oscillator frequency are heterodyned in the first mixer, producing the first IF frequency of 40.4 MHz. The 40.4 MHz IF is applied to the second mixer through an IF transformer tuned to pass 40.4 MHz.

(2) The second local oscillator is also a crystal-controlled oscillator which generates a fixed frequency of 34.4 MHz signal. This signal is also routed to the second mixer where it is heterodyned with the 40.4 MHz input from the first mixer, producing the second IF of 6 MHz. This second IF signal is coupled through an IF transformer, tuned to pass 6 MHz, to a three-stage IF amplifier section. Coupling between each stage of the IF amplifier is accomplished by an IF transformer. The four IF transformers, which contain a total of eight tuned circuits, are stagger-tuned to produce an IF bandwidth with a broad, rather flat, top with steep sides.

(3) The output of the third IF amplifier stage is detected and fed through a noise limiting circuit which cuts off audio during the reception of high-amplitude noise pulses. The noise-limiting circuit can be bypassed by closing a NOISE LIMITER SWITCH if desired. From the noise-limiting circuit, the audio signal is routed to the first audio amplifier, the squelch-quieting circuit. It also controls operation of the squelch circuit. The outputs of both the first audio amplifier and the squelch quieting circuit are connected to the second audio amplifier. When the first audio amplifier is cut off by the squelch circuit, an attenuated audio signal is bypassed through the squelch quieting circuit to the second audio amplifier. The output of the second audio amplifier is routed to

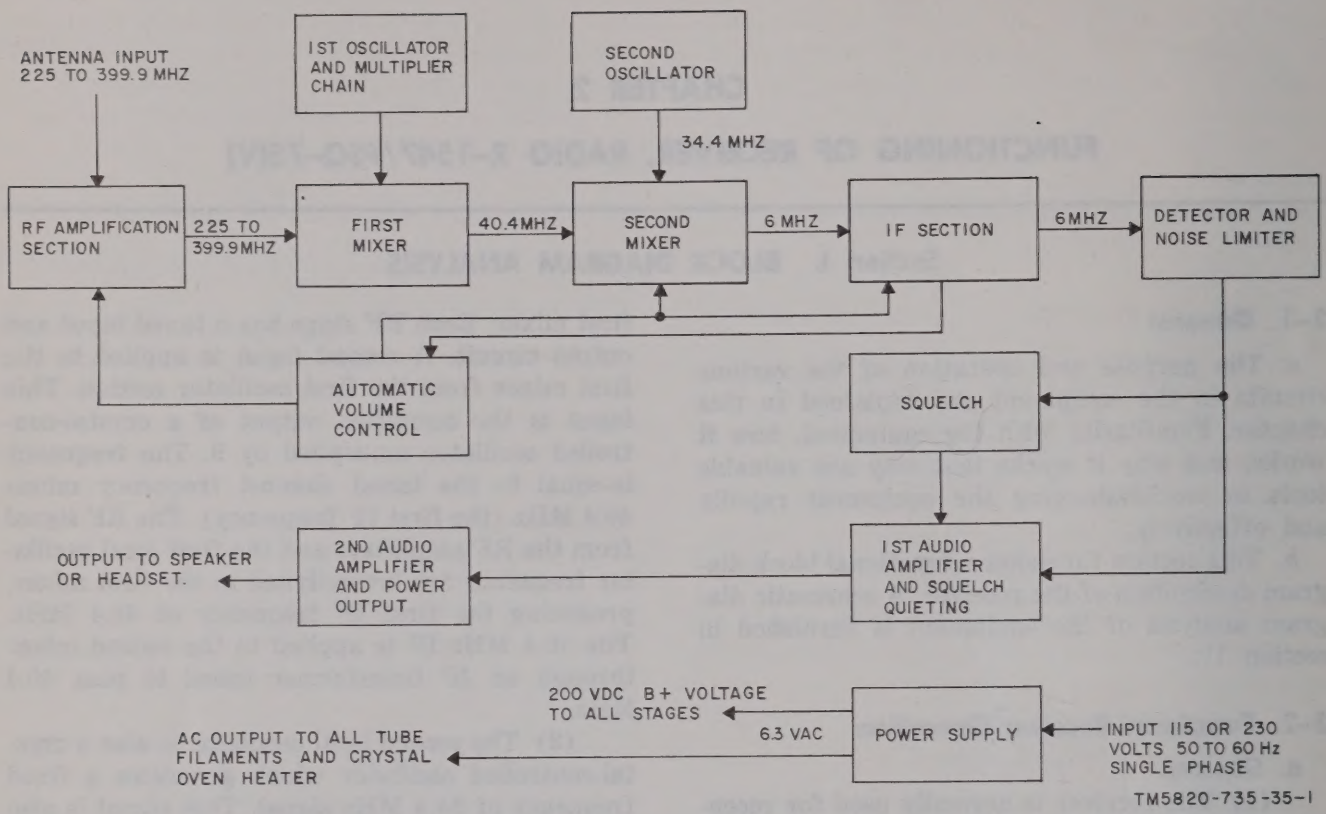


Figure 2-1. Overall block diagram.

the power output amplifier. The output from the power amplifier is connected through pads and RF filters to terminals on the rear of the receiver, and to an AUDIO OUTPUT jack on the front panel of the receiver.

(4) Part of the output signal from the third IF amplifier is applied to the automatic volume control (avc) amplifier and avc detector to produce the dc avc voltage. The avc voltage is applied to the three RF amplifiers, the second mixer and the three IF amplifiers to vary the gain of the receiver to compensate for varying input amplitudes. This maintains the output at a relatively constant level.

(5) The squelch circuit cuts off the receiver when the input signal is below a predetermined level, or causes the receiver to furnish a considerably reduced output as determined by the setting of the AUDIO QUIETING DB control.

(6) The power supply accepts an input of either 115 or 230 volts, 50 to 60 Hz, rectifies the input and provides a dc output voltage which is used as B+ supply voltage by all tubes in the receiver. A secondary winding on the power transformer provides 6.3v ac which is used as a filament supply voltage by all tubes in the receiver and also operates crystal oven A501.

Section II. SCHEMATIC DIAGRAM ANALYSIS

2-3. General

A description of all electronic and electrical functions of all circuitry contained in the receiver is provided in the following paragraphs. The functional analysis is referenced to the receiver schematic diagram provided in figure 5-2 unless otherwise noted.

2-4. First and Second RF Amplifiers

V401 and V402, the first and second RF amplifiers, are grounded-grid triode amplifiers with parallel-tuned input and output circuits. The tuned circuits are variable and must be adjusted to pass the frequency of the channel to be received. The gain of each stage is controlled by the auto-

matic volume control (avc) circuit, which sets the dc level of the triode grids. Input signals from ANT. INPUT connector J401 are routed through tuned circuit U401 to the cathode of the first RF amplifier. Amplified signals from the plate of the first RF amplifier are coupled through tuned circuit U402 to the cathode of the second RF amplifier, V402. The amplifier output of the second RF amplifier is coupled through tuned circuit U403 to the grid of third RF amplifier, V403.

2–5. Third RF Amplifier

V403, the third RF amplifier, is a pentode amplifier with tuned input and output circuits. The gain of the stage is controlled by the avc voltage which sets the dc level on the control grid. Output signals from V403 are taken from the plate, routed through capacitor C423 and tuned circuit U404, and applied to the control grid of first mixer V404. U404 must be tuned for resonance at the desired frequency when the receiver is aligned for a specific channel frequency.

2–6. First Oscillator and Tripler

The first oscillator is a Butler-type circuit, crystal controlled oscillator. The crystal, Y501, is mounted in a thermostat controlled crystal oven, A501, to prevent temperature changes from affecting the crystal frequency. The circuit is a two-stage amplifier with sufficient positive feedback to sustain oscillations. A positive pulse at the cathode of grounded-grid amplifier V501A produces a rise in cathode voltage. The rise in cathode voltage produces a corresponding decrease in plate current and a consequent increase in plate voltage which is coupled to the grid of V501B. The voltage on the grid is followed by the cathode voltage, which is then coupled back through crystal Y501 to the cathode of V501. At resonance, the crystal forms a low impedance path of less than 40 ohms. The plate load of grounded-grid amplifier V501A is tuned to the crystal frequency; however, the plate load of V501B is tuned to the third harmonic of the crystal frequency (three times the fundamental frequency of the crystal). Thus, because of the low impedance of the crystal at resonance, there is sufficient feedback from the second stage (V501B) to the first stage (V501A) to sustain oscillations. The output is taken from the plate of V501B. Since the plate load of V501B is tuned to the third harmonic of the crystal frequency, the output is a sine wave of frequency equal to three times the fundamental frequency of the crystal. Inductor L505 is connected in parallel with Y501 to prevent spurious oscillations in the event Y501 fails. This is necessary since the crystal holder capacitance offers a low impedance path between the cathodes of the two stages when the crystal fails. The resultant parallel resonant circuit of the capacitance and the inductor has sufficiently high impedance to effectively open the cathode feedback circuit if the crystal fails.

2–7. First Amplifier, Second Tripler, And Second Amplifier

The first amplifier, V502, is a pentode operated as a standard class C amplifier. The input is the output of the first tripler, V501B, and is applied to the control grid of V502. The amplified output of V502 is taken from the tuned plate circuit. The output is routed through capacitor C510 to the control grid of second tripler V503. V503 is also a class C pentode amplifier; however, the plate circuit is tuned to pass a frequency three times that of the input making the output frequency nine times the fundamental crystal frequency. This frequency is applied via capacitor C518 to the control grid of second amplifier V504. The plate circuit of V504 is tuned to pass the input frequency. The amplifier output is taken from a tap on the tuned tank in the plate circuit of V504 and routed through capacitor C427 to the cathode of first mixer V404.

2–8. First Mixer

V404, the first mixer, is a pentode tube which combines the signal applied to the cathode from the first local oscillator and the amplified RF input signal from the third RF stage. The crystal selected for use in the first local oscillator must generate a frequency equal to the desired channel frequency in megahertz minus 40.4 megahertz divided by nine. This frequency is subsequently multiplied by nine before application to the first mixer. Heterodyning of the two signals applied to the first mixer produces one signal frequency of 40.4 MHz. This is the first IF frequency, and is routed through transformer T301 to the grid of the second mixer, V301.

2–9. Second Oscillator

The second oscillator is a twin triode amplifier, V505A and V505B, which is crystal controlled. The fundamental frequency of crystal Y502 is 34.4 MHz. The oscillator is a Butler-type circuit and oscillations are sustained in the same manner

as in the first oscillator (para 2-6). The plate load of V505B is tuned to the fundamental frequency of Y502. The output of the oscillator is taken from the plate of V505B, and routed to the control grid of second mixer V301. J505 (fig. 3-3), connected to pin 2 of V505A, provides a test point for monitoring performance of the circuit.

2-10. Second Mixer

V301, the second mixer, is a pentagrid converter biased by avc voltage connected through decoupling coil L307 and routed to the third grid together with the first IF signal (40.4 MHz) from the first mixer. The 40.4 MHz signal is heterodyned with the 34.4 MHz input from the second local oscillator. The heterodyning action produces a 6 MHz beat frequency as the second IF frequency of the receiver. The plate load of V301 is tuned for 6 MHz and the 6 MHz IF is passed through transformer T303 to the control grid of V302, the first IF amplifier.

2-11. IF Amplifiers

Three stages of IF amplification are furnished by V302, V303, and V304. All three are pentode amplifiers and operate similarly. In each case, the IF signal to be amplified is applied from the secondary of an IF transformer to the control grid of the next stage. The dc level at the control grid of each amplifier is controlled by avc voltage. The four IF transformers, T303, T304, T305, and T306 are stagger-tuned to produce a wide bandpass characteristic (fig. 2-2). Cathode bias of the first and second IF stages is controlled by RF GAIN control R309.

2-12. Second Detector and Noise Limiter

a. V305A, the second detector, is a diode connected between one end of the secondary of T306 and ground. The diode operates as a half-wave rectifier to eliminate one-half of the amplitude-modulated IF signal. The remaining IF component of the signal from the secondary of T306 is filtered out by capacitor C324 and the resulting audio signal is fed through two separate filters. One of the filters, consisting of resistors R322 and R323, and capacitor C325, due to the low value of C325, has no effect on the signal except to complete the removal of any IF ripple. The result of this action is application of a pure audio signal to the plate of noise limiter diode V305B. The other filter, consisting of resistors R324, R325 and capacitor C326 removes both the IF component and the audio signal, leaving essentially dc voltage. The dc voltage level changes slowly in response to changes in signal strength and is applied to the cathode of diode V305B.

b. Because of the polarity of second detector diode V305A, a negative half-wave rectified signal is present at the junction of resistors R324 and R322. Therefore, when NOISE LIMITER SWITCH S303 is set to ON (open), the voltage at the cathode of V305B is more negative than the voltage at the plate due to the voltage divider action of R322 and R323. Consequently, V305B conducts, and audio signals appearing on the plate are passed across the diode and coupled from the V305B cathode to first audio amplifier V306A. Potentials present at the cathode of V305B are also coupled through R358 and R338 to the control grid of squelch amplifier V307A. If a high amplitude noise pulse is received, the dc voltage at the cathode of V305B does not change due to the slow response time of the filter network. However, the voltage at the plate becomes more negative, causing the diode to cut off, and no audio signal is coupled to the first audio amplifier. When the NOISE LIMITING SWITCH is closed, V305B is bypassed and all signals are applied direct to the first audio amplifier. J304 is a convenient test jack for monitoring performance of the IF circuitry.

2-13. First Audio Amplifier and Squelch Circuit

a. When there is a weak or no signal input, objectionable hiss or roar may exist in the loudspeaker or headphone set monitoring the audio output of the receiver during such periods. The purpose of the squelch circuit is to eliminate this objectionable noise. The audio input to the first audio amplifier, V306A, is applied from the second detector and noise limiter stage via AF GAIN control R327, and permits adjustment of the audio output level. A direct-coupled squelch amplifier, V307A, and a squelch diode, V308A, are connected in the grid cathode circuit of the first audio amplifier. Operation of V307A is controlled by the cathode potential of V305B which is applied to the control grid of V307A. Operation of V307A controls conduction through diode V308A. When the SQUELCH switch in ON (open), operation of diode V308A determines operation of first audio amplifier V306A. When V308A conducts, bias on the control grid of V306A permits the tube to conduct and furnish normal amplification to the audio signal. When V308A is cut off, V306A is biased beyond cutoff. However, V306B is connected in parallel with V306A. Therefore,

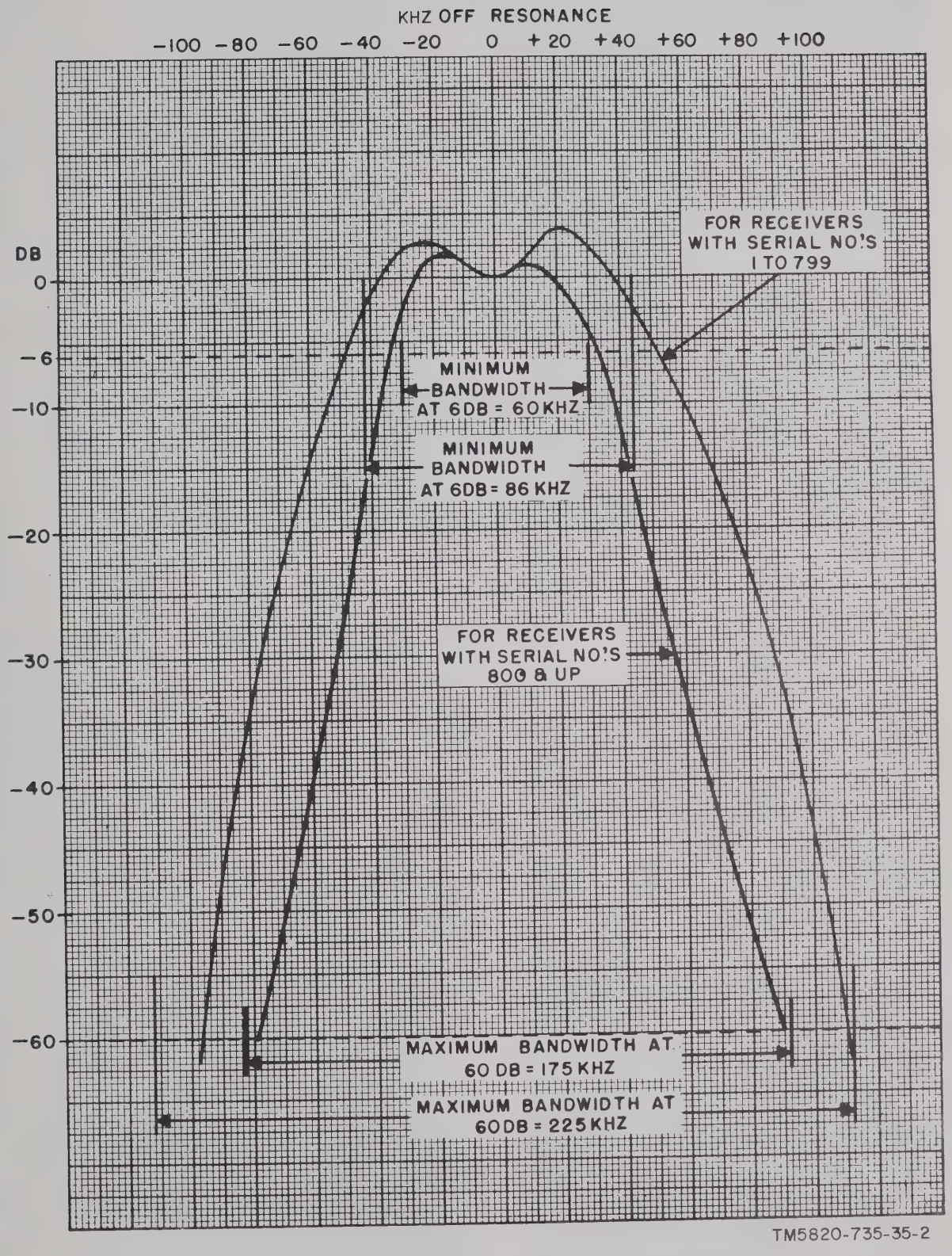


Figure 2-2. Receiver bandwidth curves.

when V306A is cut off, V306B can operate, depending on the setting of potentiometer R333, the AUDIO QUIETING DB control, to provide a reduced audio output when V306A is cut off.

b. When low level or no RF signal is available to the receiver, the voltage applied to the control grid will not be sufficiently negative to drive V307A to cutoff. Consequently, V308A cannot conduct and V306A will be cut off. Resistor R337 in the grid circuit of V306A is the plate load of V307A. The value of R337 is much greater than the plate resistance of V307A; therefore, a relatively strong plate current will cause a substantial voltage drop across R337, causing the plate of V307A to be at a low potential. The plate of V308A is also at a low potential and the cathode is more positive than the plate because of the B+ voltage fed through R340 and R341 to the cathode. Consequently, V308A cannot conduct and V306A is biased to cutoff. As the RF input signal becomes stronger, voltage applied to the control grid of V307A becomes more negative. When the voltage becomes sufficiently negative to drive V307A to cutoff, squelch diode V308A conducts since its plate voltage rises when V307A is cut off. The bias on V306A is now determined by grid resistor R328 and cathode resistor R330. Resistor R330 is unbypassed to decrease audio distortion. V306A conducts, furnishing amplification to the audio signal and the receiver is capable of providing its designed power output. When SQUELCH switch S302 is set to OFF (closed) the squelch circuit is effectively bypassed and the first audio amplifier amplifies all input signals. The output is coupled from the plate of V306 through capacitor C332 to the control grid of V307B, the second audio amplifier. When the SQUELCH switch is set to ON, the input signal strength needed to overcome the squelch is determined by the setting of RF GAIN control R309 which sets the amount of amplification furnished by the three IF amplifiers. As the gain of the IF amplifiers is decreased, a more powerful signal is required at the input to the receiver to produce sufficient voltage to overcome the squelch. If RF GAIN control R309 is set to make the receiver operate with a 5-microvolt RF input signal, a lower level input signal will produce an audio output only if AUDIO QUIETING DB control R333 is set higher to provide a signal input to V306B sufficiently high to produce an audible output.

2–14. Second Audio Amplifier and Power Output

Triode V307B amplifies the audio signal received from the first audio amplifier stage and couples the signal through capacitor C335 to the control grid of power output amplifier V309. V309 is a beam power tube which supplies sufficient amplification to the audio input signal to supply the required output power to the primary of output transformer T308. The secondary of T308 is connected to AUDIO OUTPUT jack J301 on the front panel of the receiver in parallel to terminals 1 and 2 of terminal board E303 on the rear of the receiver. All audio outputs are passed through LC RF filters. A pad consisting of resistors R346, R347, and R348 applies a 15-dbm power output across terminals 3 and 4 on terminal board E303 when terminated across a 600-ohm load while AF GAIN control R327 is set to deliver 1 watt of audio power into a 600-ohm load connected to AUDIO OUTPUT jack J301 or across terminals 1 and 2 on E303. The center tap of T308 is connected to terminal 5 on E303 and terminal 6 is grounded. Jumpering pins 5 and 6 results in an audio output signal balanced to ground. The output available across terminals 3 and 4 on E303 is furnished to provide local or remote monitoring of the audio output. Terminals 1 and 2 are provided for a muting circuit. In installations where a receiver and transmitter are connected to operate on a common antenna system, the muting terminals may be connected to a shorting relay in the transmitter. When the transmitter is operating, the audio output of the receiver is terminated across a 600-ohm dummy load to prevent the receiver output from operating when the transmitter is operated. The output from terminals 1 and 2 can also be connected to a remote switching relay so that the audio output can drive a remote speaker when the associated transmitter is not operating. When the transmitter operates, the switching relay switches the audio power to a 600-ohm terminating resistor. Figure 2–3 is an audio frequency response curve for the receiver.

2–15. Automatic Volume Control

a. The function of the automatic volume control (avc) circuit is to permit maximum gain until a predetermined RF input level is available, then reduce the gain of the receiver as the RF input level increases in order to provide a constant output level (fig. 2–6). This receiver uses an amplified, delayed avc with a forward feed. Figure 2–4 illustrates the characteristic curves for various avc circuits. As illustrated, with no avc, the output is proportional to the input limited only by some practical considerations such as the signal handling capabilities of tubes in the various stages of the receiver. When ordinary avc is used, the output is no longer proportional to the input as the avc goes into action as soon as an RF sig-

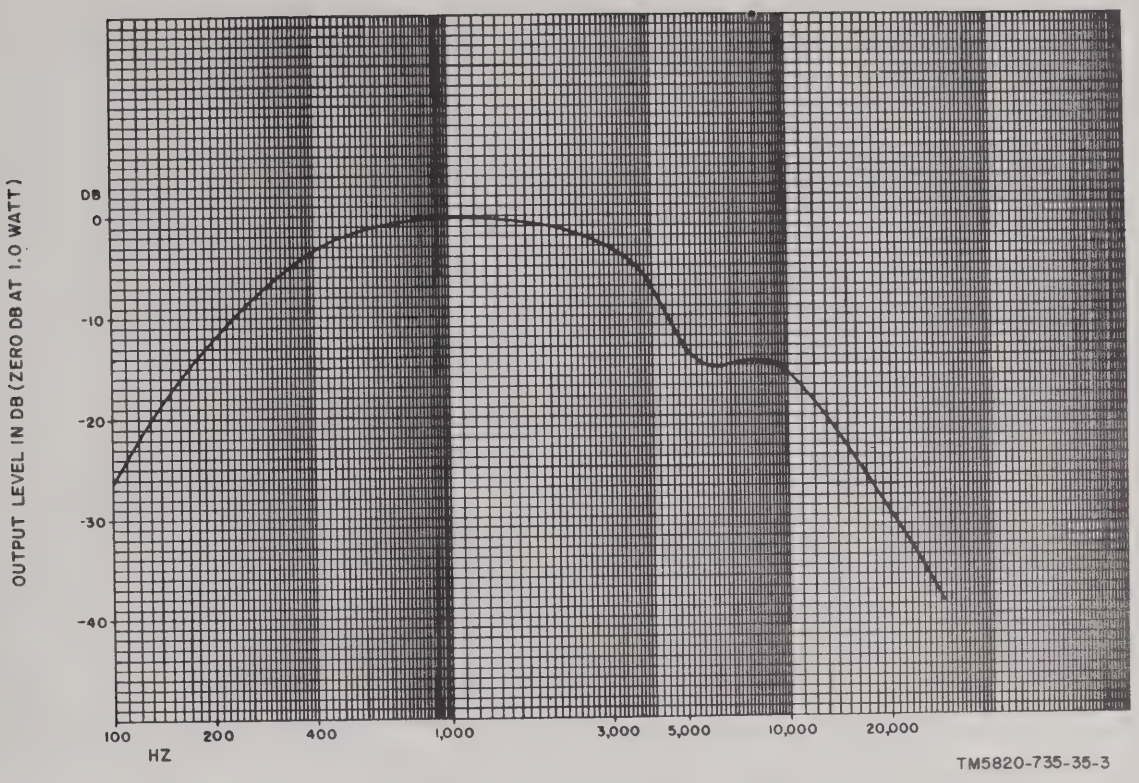


Figure 2–3. Receiver audio frequency response curve.

nal is received and tends to reduce the gain of the receiver as large signals are received. An amplified avc is characterized by a more rigid control of the output, and delay in the operation of the avc circuit permits a usable output for a lower level input because the avc circuit cannot operate until the delay has been overcome. If a portion of the avc voltage is fed to a stage following the avc takeoff point (amplified, delayed avc with forward feed), a more constant output is furnished for variable input signals. For comparison, note in figure 2–4 that, with an input RF signal with amplitude of e_1, ordinary avc without delay produces an output amplitude of E_1, but amplified avc with delay produces an output amplitude of E.

b. Refer to figure 2–5 while following the description of the operation of the avc circuit below. Input to avc amplifier V310 is coupled through C340 from the plate of the second IF amplifier, V303, and applied to the control grid of pentode amplifier V310. This input signal is the 6 MHz second IF. V310 is biased to conduct with no signal input, creating a voltage drop across R354 which places the cathode of avc detector V308B above ground (point No. 1). At this time, the plate of V308B (point No. 2) is at ground potential and V308B cannot conduct. When an ac input is available at the control grid of V310, the signal is amplified and coupled through T302 to the plate of V308B. When the positive potential on the plate of V308B is greater than the dc voltage drop across R354, V308B conducts and a negative voltage exists at the junction of R353 and C344 (point No. 3). This is essentially the avc voltage, and it varies as the RF input level varies. The voltage across R354 is the avc delay voltage as it determines the input signal strength necessary to cause V308B to conduct, creating the negative avc voltage which decreases the gain of the receiver. The avc voltage thus developed is applied to the three RF amplifiers, the second mixer and the three IF amplifiers. AVC METER jack J303 is connected to the output of the avc circuit to provide an accessible test point for measuring the avc voltage. Test jack J506 (fig. 5–2, connected at point No. 4) is provided as a convenience jack for shorting out avc during performance of receiver alignment procedures.

2–16. Power Supply
(fig. 5–2)

A full-wave rectifier power supply is used in the receiver. Rectifiers V311 and V312 are connected

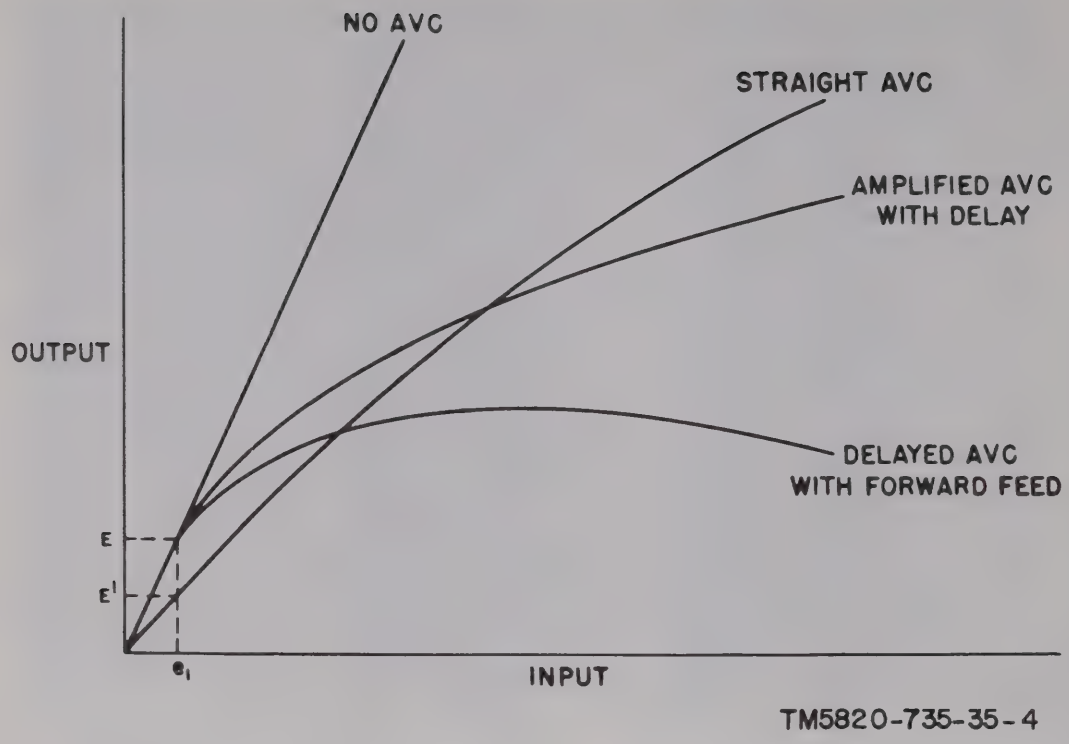


Figure 2-4. Automatic volume control characteristics.

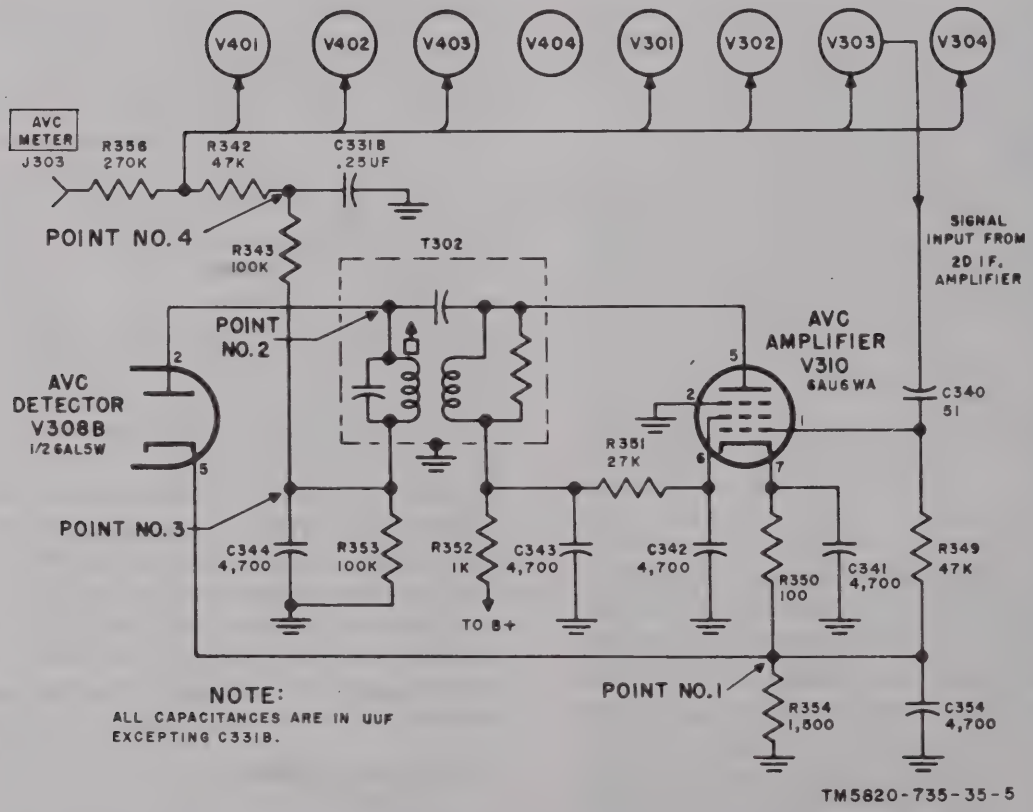


Figure 2-5. Automatic volume control, simplified schematic.

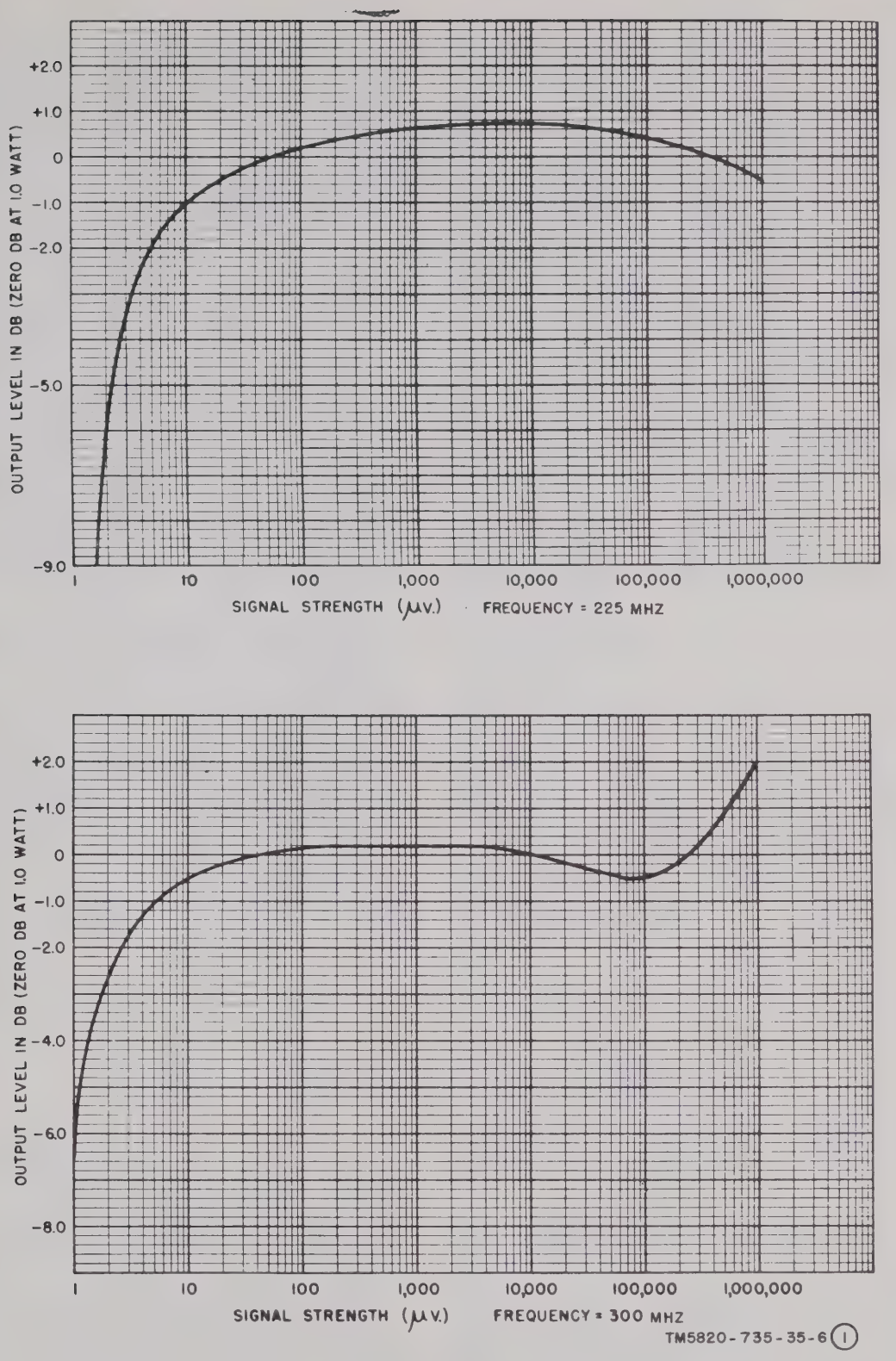


Figure 2-6(1). Receiver automatic volume control curves (part 1 of 2).

in parallel to provide sufficient current for operation of the receiver. An inductive-capacitive pi filter is used for ripple reduction, and the output of the power supply (B+ line) is fused with a 1/4-ampere fuse, F302, to protect internal circuitry in the receiver. The 6.3v ac secondary of transformer T307 provides filament voltage for all tubes in the receiver with the exception of recti-

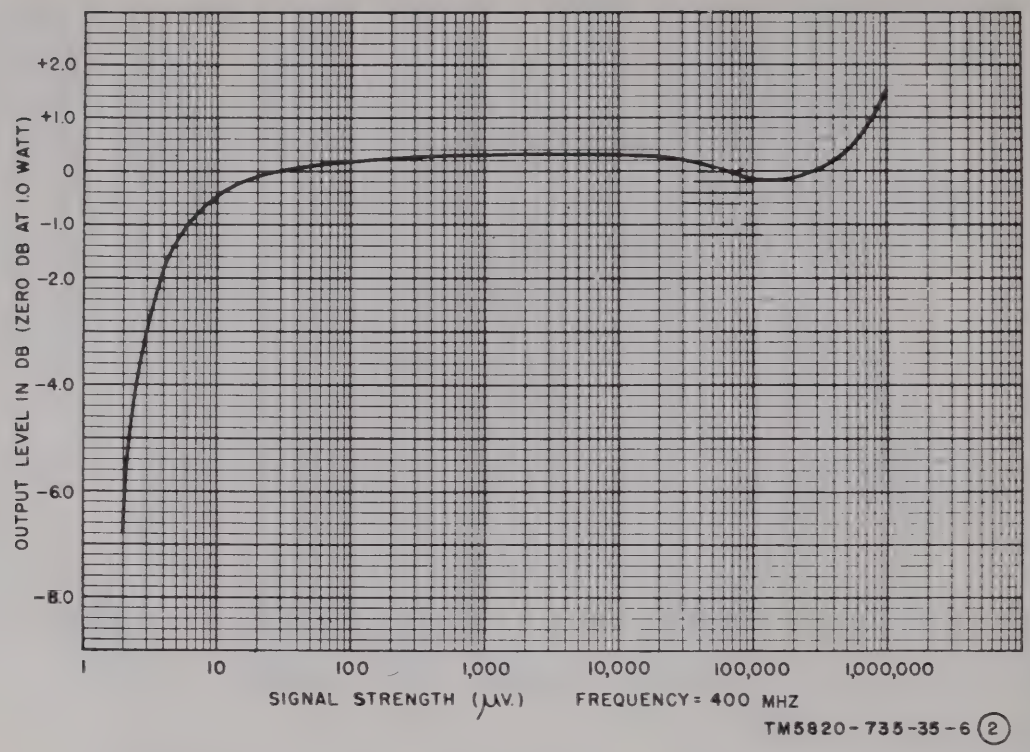


Figure 2-6(2). Receiver automatic volume control curves (part 2 of 2).

fiers V311 and V312. The 6.3v ac also illuminates PILOT LIGHT E301 to indicate ac power is applied to the receiver, and supplies power necessary to operate crystal oven A501. When 115v ac is used to power the receiver, the two primary windings of T307 are connected in parallel. When a 230v ac is used to power the receiver, the two primary windings are connected in series. Input leads to the transformer from the power line are RF filtered to reduce the effects of RF radiation.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE

Section I. GENERAL

3–1. Scope of Direct Support Maintenance

Direct support maintenance supplements and includes all procedures outlined for organizational maintenance (TM 11–5820–735–12) and troubleshooting techniques required to isolate trouble to a specific defective part. Corrective repair action at the direct support level includes repair or replacement of all defective parts necessary to return a defective receiver to operation. In addition, maintenance at the direct support category includes installation of the proper crystal Y501 in crystal oven A501 and alignment of the receiver necessary to insure that the equipment will operate at the required channel frequency. This category of maintenance also includes periodic checking of receiver operation and alignment and testing of the receiver to determine whether it meets performance standards necessary for return to operation.

3–2. Tools, Test Equipment, and Materials Required for Direct Support Maintenance

Tools and test equipment required for direct support maintenance are listed below. In addition to the tools and test equipment listed, a headset, type CW–49507 or equivalent is required.

Item	Purpose
Counter, Electronic, Digital Readout AN/USM–207.	Check RF and crystal frequencies.
Generator, Signal AN/URM–25F.	Furnish 6 MHz IF test signal.
Generator, Signal AN/USM–44A.	Furnish RF test signal.
Meter, Audio Level ME–356/U.	Check output power levels.
Meter, Volt ME–26/U	Check ac and dc voltages and resistance.
Multimeter TS–352B/U	Check ac and dc voltages and check continuity.
Oscillator, Audio SG–19/U	Provide modulation signal for AN/USM–44A.
Oscilloscope AN/USM–140	Signal tracing.
Test Set, Electron Tube TV–7/U.	Check electron tubes.
Toolkit K–100/G	Repair and alignment tools.
Variac CN–16/U	Adjust ac test voltage.

Section II. DIRECT SUPPORT TROUBLESHOOTING

3–3. General Instructions

Warning: **Voltages dangerous to life are present in the receiver when energized. Be careful when performing maintenance on live circuits.**

a. Systematic troubleshooting procedures begin with operational checks performed at the organizational level to isolate a trouble to the receiver. The checks are supplemented and extended by localizing and isolating techniques at the direct support category to isolate the trouble to a specific part in the defective receiver.

b. When trouble has been isolated to the receiver, performance of the maintenance functions in the following paragraphs will isolate the trouble to a specific part.

3–4. Organization of Troubleshooting Procedures

To be effective, troubleshooting must be systematic. Generally it is necessary to perform a sequence of operational checks, observations, and measurements before a defect will be revealed. If the proper sequence is used, the trouble will be traced first to a particular section of the equipment and finally to the defective part. The sequence of steps is commonly referred to as the

sectionalization, localization, and isolation of a trouble.

a. Sectionalizational. A trouble in a defective receiver should first be sectionalized to a particular section of the equipment. Defective sections are determined by an operational test.

b. Localization. When the defective section of equipment has been determined, localize the trouble to a particular stage or functionally related stages. Use inspection and operational techniques first. When necessary, use the testing procedures provided in this manual.

c. Isolation. When a trouble has been isolated to a portion of the receiver such as a stage or a group of functionally related circuits, use visual inspection, voltage measurements, tube substitution, and signal sampling techniques to determine the defective part.

3–5. General Precautions

a. Verify that all power is removed from the receiver before performing any resistance checks.

b. Observe all precautions to assure safety to personnel and equipment when making voltage and current measurements.

c. Disconnect all power, and discharge capacitors before making any resistance measurements.

d. Verify that all cable and cord connections are correct before operating or testing any item of equipment.

e. Careless or incorrect replacement of parts or repair can cause more damage and trouble than the original defect. Before unsoldering a part, note the position of the leads and parts involved. If the part (such as a transformer) has numerous connections; make notes and sketches of the original location and placement of the part and lead wires. This assures proper lead wire dress and parts location to duplicate the original condition, and minimizes the possibility of wiring errors.

3–6. Troubleshooting Procedures

The following paragraphs include procedures for sectionalization of the cause of defective receiver operation to various sections of the receiver. Procedures are also included for localizing the cause of trouble to a particular stage or group of functionally related stages. Additional procedures are provided for isolating the cause of trouble to a specific component in the receiver. Performance of an operational test (para 3–9) sectionalizes trouble to a specific section of the receiver and assists in localizing trouble to a group of functionally related stages. Performance of signal substitution tests (para 3–10), and checking B+ and filament circuits (para 3–8) localizes trouble to a stage or group of functionally related stages and in some cases may isolate the cause of defective operation to a specific component. Visual inspection (para 3–7), tube substitution (para 3–20) and voltage and resistance checks (para 3–11) aid in isolating trouble to a specific defective component. Reference to the receiver troubleshooting chart (para 3–12), when evidence of defective operation is encountered during performance of the operational test, will assist in locating the cause of trouble systematically. In addition, the possibility of intermittent trouble being the cause of defective operation should never be overlooked. Intermittent troubles normally are the most difficult to isolate. However, jarring the receiver slightly and tapping lightly on individual components with an insulated prod should make the trouble appear during performance of the operational test or the signal sampling test.

3–7. Visual Inspection

a. It is often possible to locate the source of trouble in receiver operation quickly and simply by performing a thorough visual inspection of the equipment to detect obviously damaged components.

b. Accomplish the following procedures when performing a visual inspection.

Warning: **Voltages dangerous to life are present in the receiver when it is energized or connected to a power source. Be careful when performing maintenance procedures.**

(1) Place the receiver on a clean workbench where 115 or 230 volts, 50 to 60 Hz is available, depending on the line voltage required.

(2) Remove the receiver dust cover. Removal is accomplished by depressing each of the four twistlock fasteners on the rear of the dust cover and twisting counterclockwise to disengage. Pull the dust cover straight back and off the receiver.

(3) Verify that all pluckout components are firmly seated in their respective mounting sockets.

(4) Position the receiver so that components and wiring on the bottom of the chassis are clearly visible.

(5) Perform a thorough visual inspection to locate any frayed or burned wiring, overheated resistors, leakage from electrolytic capacitors, overheated transformers, cracked crystals, bad connections, or other visible defects.

(6) Replace any obviously damaged components. Repair other obvious defects.

(7) Position receiver in upright position.

(8) Verify that POWER switch is set to OFF.

(9) Connect receiver power cord between POWER connector on rear of receiver and power source.

(10) Set POWER switch to ON and verify that PILOT LIGHT illuminates.

(11) Verify that all tube filaments glow. If necessary, remove tube shields. Removal is accomplished by pressing down lightly on the tube shield, turning slightly counterclockwise to unlock and pulling the shield straight up and off the tube.

(12) Replace defective tubes in accordance with paragraph 3–20.

(13) Perform the receiver performance tests (paras 3–27 through 3–35) after accomplishment of any repair or replacement procedures to determine that the equipment meets performance standards necessary for return to operation.

3–8. Checking Power Input, Filament, and B+ Circuits

The following checks should be performed when either fuse F301 or F302 opens immediately subsequent to replacement. The fuse which continues to open will determine the checks to be performed.

a. Checking Power Input Circuit. When F301 continues to open when replaced, set the receiver POWER switch to OFF. Perform the following procedures in the order listed to check the power input circuitry.

(1) Place the receiver on a workbench where 115 or 230 volts, 50 to 60 Hz is available, as applicable.

(2) Remove the receiver dust cover.

Warning: **Do not connect receiver power cord to power source.**

(3) Set receiver POWER switch to ON.

(4) Set TS–352B/U for OHMS function to read a low resistance (less than 10 ohms).

(5) Connect the TS–352B/U test leads across the terminals on POWER connector J302 and note the resistance reading obtained.

(6) Normal reading is approximately 1.5 ohm when T307 is connected for 115-volt operation and approximately 6 ohms when connected for 230-volt operation. If resistance reading is infinite, L313, L314, the primary windings of T307 or POWER switch S301 is open, or poor connections exist at the input terminals on T307. A short or a very low resistance reading indicates that either L313, L314 (or both) are shorted or the primary winding(s) of T307 is shorted.

(7) Inspect cable connections, remove cabling from S301, and perform further resistance readings as required to isolate the defective component.

(8) If the measured resistance was normal, proceed to (9) below.

(9) Set receiver POWER switch to OFF.

(10) Set TS–352B/U to monitor high resistance reading and connect test leads between receiver chassis ground and the center tab of C345. Note resistance.

(11) Resistance reading should be infinite. A low reading or short indicates C345 or C363 is shorted or contains a leakage path to ground.

(12) Connect TS–352B/U between receiver chassis ground and center tab of C346. Note resistance.

(13) Resistance reading should be infinite. A low reading or short indicates C346 or C364 is shorted or contains a leakage path to ground.

(14) If the above checks indicate that the power input circuit is good, proceed to *b* below.

b. Checking Filament Circuits. Perform the following procedures when making check of the filament circuits.

(1) Remove all tubes, the PILOT LIGHT lamp, and crystal oven A501 (fig. 3–7) from the receiver.

(2) Unsolder all wires from terminal 11 of T307.

(3) Set the TS–352B/U to monitor a low resistance reading and connect test leads between terminal 11 of T307 and receiver chassis ground. Note resistance reading.

(4) Normal reading should be a short. An infinite reading indicates that either the filament winding (terminal 11 to terminal 10) of T307 or the wire from terminal 10 of T307 to receiver chassis ground is open. If the normal reading is obtained, perform (5) below.

(5) Set the TS–352B/U to monitor a high resistance reading, and connect the test leads between the wires unsoldered from terminal 11 and receiver chassis ground. Note resistance reading.

(6) Resistance reading should be infinite. If a low reading or short is obtained, either a short or leakage path to ground exists in the filament circuit external to T307.

(7) Unsolder the two leads from the center tab of C428 in the RF subassembly.

(8) Connect TS–352B/U test leads between the center tab of C428 and receiver chassis ground. Note resistance reading.

(9) Resistance reading should be infinite. Zero resistance indicates a short in one or more of the filament bypass capacitors in the RF subassembly. Check C404, C410, C418, C424 and C428. If the normal resistance reading was obtained, proceed to (10) below.

(10) Connect TS–352B/U test leads between the center tab of C530 in the oscillator subassembly and receiver chassis ground. Note resistance reading.

(11) Resistance reading should be infinite. A short indicates that one or more of the filament bypass capacitors in the oscillator subassembly is shorted. Check C530, C531, C532, C536, C537 and C539.

(12) If infinite resistance was measured in (10) above, the short exists in the filament circuit on the main chassis. Resolder leads to center tab of C428.

(13) Check C304, C310, C315, C317, C320, and C353.

c. Checking B+ Circuits. B+ circuits should be checked for shorts when fuse F302 opens immediately subsequent to replacement. Accomplish the following procedures when performing the check.

***Warning:* Verify that the receiver power cord is not connected to the power source and short out dc filter capacitors before performing the procedures below.**

(1) Place the receiver on a workbench and set its controls as follows: AUDIO QUIETING DB control to full counterclockwise position, RF GAIN control to full counterclockwise position, SQUELCH switch to OFF, NOISE LIMITER SWITCH to ON, AF GAIN control to full counterclockwise position.

(2) Set TS–352B/U to OHMS function and range switch to ×1,000. Connect test leads between the hot side of C348 (terminal with red dot) and receiver chassis ground. Note resistance reading.

(3) Normal resistance reading is approximately 25,000 ohms. A reading of approximately 16,000 ohms indicates that C329 is shorted. If a reading of less than 7,000 ohms is obtained, proceed to (4) below.

(4) Unsolder the two leads from the center tab of C429 in the RF subassembly.

(5) Connect TS–352B/U test leads between the center tab of C429 and receiver chassis ground. Note resistance reading.

(6) Normal resistance reading is infinite. A reading of less than 6,000 ohms indicates a short in one or more of the plate bypass capacitors within the RF subassembly. Check C406, C407, C412, C413, C419, C423, C425, C426, C429, C431 and C433. If infinite resistance was measured, proceed to (7) below.

(7) Unsolder leads from the center tab of C529 in the oscillator subassembly. Connect TS–352B/U test leads between the center tab of C529 and receiver chassis ground. Normal indication is near infinite resistance. A reading of less than 4,000 ohms indicates that one or more of the plate bypass capacitors within the oscillator subassembly is shorted. Check C503, C506, C511, C512, C515, C517, C520, C521, C522, C525, C526, C527, C528, C529, C533, C535 and C538. If near infinite resistance is measured, the short exists in the B+ circuit on the main chassis.

(8) Resolder leads to C429 and C529 and check C347, C348, C305, C306, C311, C316, C322, C323, C338, and C343.

3–9. Operational Test

An operational test should be performed to localize the cause of defective receiver operation when the specific trouble symptom is not known. The operational test should be performed only if a visual inspection fails to isolate the cause of trouble, and it has been determined that all power supply circuitry is good. Proper use of information gained from observing faulty operation symptoms during performance will, at times, determine the exact nature of the malfunction. If used in conjunction with a schematic analysis and voltage and resistance checks, the information gained may isolate the specific defective part. Accomplish the following procedures when performing the operational test:

(1) Place the receiver on a workbench and remove the dust cover.

(2) Connect test equipment to the receiver as illustrated in figure 3–1.

(3) Set test equipment and receiver POWER switches to ON. Allow a 30-minute warmup before performance of test.

(4) Set receiver controls as follows: RF GAIN and AF GAIN controls fully clockwise, AUDIO QUIETING DB control fully counterclockwise, SQUELCH and NOISE LIMITER switches to ON.

(5) Set AN/USM–44A ATTEN control to provide 0 output.

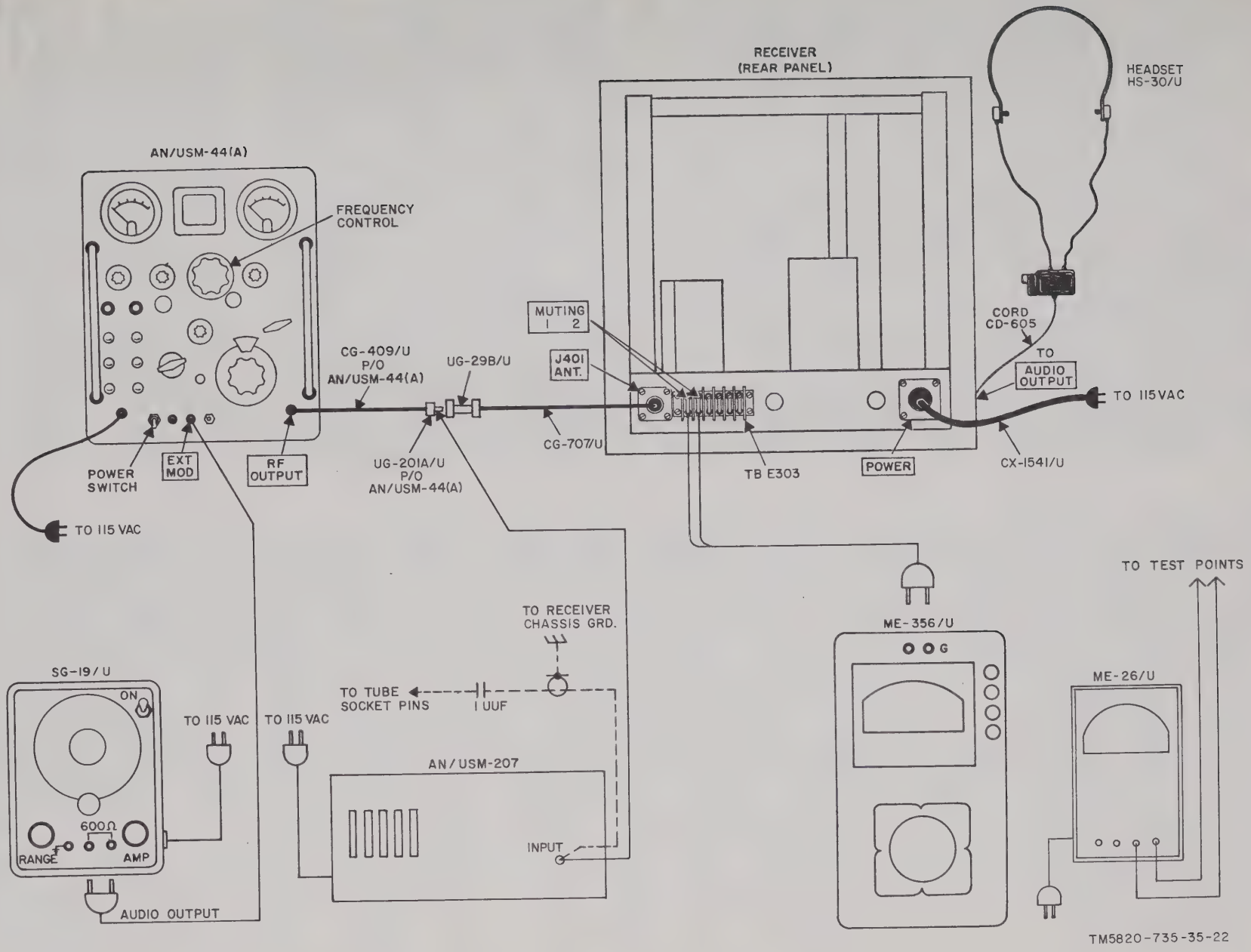


Figure 3-1. Operational test setup.

(6) Set controls on AN/USM–44A as necessary to provide an unmodulated frequency output at the receiver channel center frequency.

(7) Set AN/USM–44A controls as follows: XTAL CAL switch to OFF, XTAL CAL. GAIN control fully counterclockwise, AMP. TRIMMER fully clockwise, OUTPUT LEVEL control as required to position indicator on OUTPUT VOLTS meter to SET LEVEL (red line).

(8) Connect output of AN/USM–44A to input of AN/USM–207 and verify that output frequency of AN/USM–44A is correct.

(9) Disconnect output of AN/USM–44A from the AN/USM–207 and connect to ANT. jack J401 on the receiver.

(10) On AN/USM–44A set MOD. SELECTOR to 1,000 Hz and adjust MOD. LEVEL control as required to obtain reading of 30 on PERCENT MODULATION meter.

(11) Verify that AN/USM–44A ATTEN is set fully counterclockwise.

(12) Disconnect ME–356/U from receiver and connect headset to AUDIO OUTPUT jack J301 on front panel of receiver.

(13) Output of receiver as monitored through the headset should be quieted. If this condition does not exist, slowly rotate the RF GAIN control counterclockwise until the output is quieted.

(14) Slowly rotate the AN/USM–44A ATTEN control clockwise until sound is heard in the headset. Note and record the output voltage from the AN/USM–44A. The output voltage should not exceed 1.5 microvolt. If the specified result is obtained, proceed to (21) below.

(15) If the result specified in (14) above is not obtained, set the receiver POWER switch to OFF. Connect a jumper from J506 (fig. 3–3) on the receiver to receiver chassis ground.

(16) Set ME–26/U to monitor –10V dc and connect DC test probe to J304 and COMMON lead to chassis ground.

(17) Set receiver POWER switch to ON.

(18) Set AN/USM–44A ATTEN control to 3 microvolts.

(19) ME–26/U should read between 1.5 and 8 volts.

(20) If the result specified in (19) above is obtained, the RF, IF, and oscillator sections of the receiver are operating properly and the squelch circuit is defective. Check tubes V307, and V308. If the tubes are good, perform voltage and resistance measurements for V307 and V308 circuitry necessary to isolate the defective part.

(21) Adjust the AF GAIN control for a comfortable listening level at headset. Verify that a clear, nondistorted 1 kHz tone emanates from the headset. If distortion is present, perform signal substitution test (para 3–10*c*) to isolate cause.

(22) Disconnect the headset from the receiver and connect ME–356/U to pins 1 and 2 on E303 at rear of receiver. Set the IMPEDANCE control on ME–356/U to 60 on X10 scale and depress +20 RANGE switch.

(23) Set AN/USM–44A ATTEN to 50 microvolts. Note and record reading on ME–356/U.

(24) ME–356/U reading should be minimum of +10 db. If the specified reading is not obtained, perform signal substitution test (para 3–10*c*) to determine cause of low output.

(25) Rotate AF GAIN and RF GAIN controls counterclockwise then clockwise.

(26) Output level should decrease when each control is turned counterclockwise and increase when the controls are turned clockwise. Check the applicable potentiometer if the specified result is not obtained.

(27) If all tubes glow, but the receiver is inoperative, connect input of AN/USM–207 to pin 1 of V302 via a coaxial cable. Connect the center conductor of the coaxial cable to pin 1 via a 1-$\mu\mu$f capacitor. Connect cable shield to receiver chassis ground.

(28) Note frequency count displayed on AN/USM–207. Frequency should be 6 MHz.

(29) If the correct frequency count is displayed, the RF and oscillator sections of the receiver are operating properly. If the correct count is not displayed, proceed to (30) below.

(30) Connect the AN/USM–207 to pin 1 of V301 using connection procedures outlined in (27) above.

(31) Frequency count displayed on the AN/USM–207 should be 34.4 MHz. If the proper count is displayed, proceed to (32) below. If the proper count is not displayed, crystal Y502 or the second oscillator stage circuitry is defective.

(32) Connect AN/USM–207 to pin 2 of V404 using connection procedures outlined in (27) above.

(33) Frequency count displayed on the AN/USM–207 should equal the channel center frequency of the receiver –40.4 MHz ±10 kHz. If the specified count is obtained, proceed to (34) below. If the correct count is not obtained, crystal Y501 or oscillator subassembly circuitry is defective.

(34) Connect the AN/USM–207 to pin 1 of V404 using connection procedures outlined in (27) above. The frequency count displayed should equal the channel center frequency of the receiver. If the correct count is not obtained, circuitry of the first, second. or third RF stages is defective.

3–10. Signal Substitution Tests

a. General.

(1) Performance of signal substitution tests will isolate trouble in the receiver to a specific stage. In addition, information gained from the tests, used in conjunction with voltage and resistance checks (para 3–11) and a schematic analysis, should isolate the cause of defective operation to a specific component. When these procedures fail to determine the cause of defective operation, such as a weak signal output from a stage, check the RF and IF alignment of the receiver (sec III).

(2) The tests are predicated on applying a simulated operational signal to the input of the last stage in a group of functionally related stages, and checking for the proper output. This procedure is systematically repeated, working back in the group of related stages to locate the defective stage. A defective stage is recognized when the proper input is supplied, but the normal output is not available. When a defective stage is located, check the tube in the stage and make voltage and resistance measurements (para 3–11) necessary to isolate the defective component. When performing the test, accomplish the procedures for each section in the order listed.

b. Power Supply Voltages. Since all the circuits in the receiver depend on proper supply voltages for normal operation, it is recommended that the points listed below be checked to determine that the required voltages are present before proceeding with the signal sampling tests. Use the ME–26/U to measure the voltages. Accomplish the following procedures when performing the checks. Parts location illustrations (figs. 3–6 through 3–11) and the receiver wiring diagram (fig. 5–3) will aid in locating the test points.

Warning: **Voltage potentials dangerous to life exist in the receiver circuitry when the receiver is energized. Be careful when performing the procedures.**

(1) Place the receiver on a workbench and remove the dust cover.

(2) Verify that the receiver POWER switch is set to OFF and connect the ac power cord between the receiver and the line power source (115 or 230 volts, 50 to 60 Hz, as applicable).

(3) Set the receiver POWER switch to ON and verify that the PILOT LIGHT illuminates.

(4) Set the ME–26/U as required to monitor +300v dc and connect the COMMON test lead to receiver chassis ground.

(5) Connect ME–26/U DC test probe to center tab of C429 in RF subassembly (fig. 3–9).

(6) ME–26/U should read approximately 205 volts.

(7) Connect ME–26/U DC test probe to junction of R341 and R315 (figs. 3–8(2) and 3–11).

(8) ME–26/U should read approximately 135 volts.

(9) Connect ME–26/U DC test probe to center tab of C521 in the oscillator subassembly (fig. 3–10).

(10) ME–26/U should read approximately 200 volts.

(11) Set ME–26/U to monitor 10v ac.

(12) Connect AC test probe on ME–26/U to center tab of C428 in the RF subassembly.

(13) ME–26/U should read approximately 6.3 volts.

(14) Connect ME–26/U AC probe to center tab of C530 in the oscillator subassembly.

(15) ME–26/U should read approximately 6.3 volts.

(16) In the event an abnormal reading is encountered during performance of the above checks, refer to paragraph 3–8 and perform the specified procedures necessary to isolate the cause of the abnormal readings.

c. Af Stages. Accomplish the following procedures when performing a signal substitution test of the af section of the receiver:

Note. Allow test equipment requiring ac power approximately a 30-minute warmup prior to using.

(1) Verify that receiver POWER switch is set to OFF.

(2) Set the SG–19/U to provide an output frequency of 1,000 Hz.

(3) Connect output of SG–19/U to pin 1 of V309 via a 50-ohm coaxial cable. Couple the center conductor of the coaxial cable to pin 1 through a 0.5 μf capacitor. Connect the shield of the coaxial cable to receiver chassis ground.

(4) Connect the input of the ME–356/U across MUTING terminals 1 and 2 of terminal board E303 on the rear of the receiver.

(5) Set IMPEDANCE control on ME–356/U to 60 on X10 scale and depress +20 RANGE switch. Connect one vertical input of the AN/USM–140 across pins 1 and 2 of E303.

(6) Set ME–26/U to monitor 30v ac and connect AC test probe across output of SG–19/U.

(7) Set receiver controls as follows: QUELCH switch OFF, NOISE LIMITER SWITCH ON, AF GAIN, AUDIO QUIETING DB and RF GAIN controls fully clockwise.

(8) Set receiver POWER switch to ON. Verify that PILOT LIGHT indicator illuminates

immediately and that all tube filaments glow after a short period of time.

(9) Set AMPLITUDE control on SG–19/U to obtain a reading of 10 volts on the ME–26/U.

(10) Disconnect the ME–26/U from the SG–19/U output.

(11) Monitor ME–356/U reading. Reading should be a minimum of +10 dbm.

(12) Set AN/USM–140 controls as required to obtain the best presentation of the sine wave output. The oscilloscope display should be a symmetrical 1 kHz sine wave with no evidence of distortion or clipping.

(13) If results are as specified in (11) and (12) above, proceed to (14) below. If output is low, V309 is probably weak. If a distorted output is present, V309 is probably defective. If no output is present, check all components of the power output stage and all components associated with the output circuitry of T308.

(14) Set receiver POWER switch to OFF.

(15) Set AMPLITUDE control on SG–19/U fully counterclockwise and disconnect from pin 1 of V309.

(16) Connect output of SG–19/U to pin 7 of V307 as specified in (3) above.

(17) Set ME–26/U to monitor 1v ac and connect AC test probe across output of SG–19/U.

(18) Set receiver POWER switch to ON.

(19) Adjust AMPLITUDE control on SG–19/U to obtain reading of 0.47 volt on ME–26/U; disconnect ME–26/U from output of SG–19/U.

(20) Repeat (11) and (12) above. Output should be as specified.

(21) If the normal output is present, proceed to (22) below. If output is low, V307 is likely weak. If the output is distorted, V307 is defective or biasing components are out of tolerance. If no output is available, check V307 stage components.

(22) Set receiver POWER switch to OFF.

(23) Set SG–19/U AMPLITUDE control fully counterclockwise; disconnect SG–19/U from pin 7 of V307A.

(24) Connect 100K and 11K, 1/2-watt, 5-percent resistors in series across the output of the SG–19/U.

(25) Connect the junction of the two resistors to J304 on the receiver. Connect the other end of the 11K resistor to receiver chassis ground.

(26) Connect the ME–26/U AC test probe directly across the output of the SG–19/U, and adjust the AMPLITUDE control on the SG–19/U to obtain a reading of 0.38 volt on the ME–26/U (input voltage at J304 will be .038 volt). Disconnect the ME–26/U.

(27) Repeat (11) and (12) above. Output should be as specified.

(28) Rotate AUDIO QUIETING DB control fully counterclockwise, then fully clockwise.

(29) Output registered on the ME–356/U should decrease as the control is turned counterclockwise and increase as the control is turned clockwise.

(30) If the output is as specified in (11), (12), and (29) above, the audio section of the receiver is good. Proceed to *d* below. If the output specified in (27) above is low, V306 is weak or C329 or C331A is open. If no output is available, check V306 stage circuitry. If the output does not vary as the AUDIO QUIETING DB control is rotated, R332 or R333 is defective.

(31) Set receiver POWER switch to OFF and disconnect the SG–19/U and AN/USM–140 from the receiver. Leave the ME–356/U connected so that the output of the receiver will be properly terminated during further testing.

d. IF Amplifiers, Second Mixer, and Second Detector. Accomplish the following procedures in the order listed when performing a signal sampling test of the IF amplifier, second mixer, and second detector sections of the receiver:

(1) Verify that receiver POWER switch is set to OFF.

(2) Set ME–26/U to monitor –3v dc.

(3) Connect DC test probe to J304 on receiver and the COMMON test lead to receiver chassis ground.

(4) Connect jumper from J506 on the receiver to receiver chassis ground to short out avc.

(5) Set receiver controls as follows: RF GAIN, AF GAIN, and AUDIO QUIETING DB controls to fully clockwise position, SQUELCH and NOISE LIMITER SWITCH to OFF.

(6) Set AN/URM–25F controls as necessary to provide an unmodulated 6 MHz output.

(7) Connect the output of the AN/URM–25F to the input of the AN/USM–207 and verify that the output is 6 MHz.

(8) Disconnect the AN/URM–25F from the AN/USM–207 and set the output level of the AN/URM–25F to 0.

(9) Connect output of AN/URM–25F to pin 1 of V304 using test lead CX–1363/U, supplied with the signal generator, to make the connection. Connect the red lead to pin 1 of V304 and the black lead to receiver chassis ground.

(10) Set receiver POWER switch to ON.

(11) Adjust output level of AN/URM–25F for 150,000 microvolts.

(12) ME–26/U should read 1.5 volt ±0.5. If the normal reading is obtained, proceed to (13)

below. If abnormal reading is obtained, V304, V305, or T306 is likely defective. The abnormal reading could also be caused by defective circuitry.

(13) Set output level of AN/URM–25F to 15,000 microvolts and connect red lead from AN/URM–25F to pin 1 of V303.

(14) ME–26/U should indicate same reading as obtained in (12) above with output of AN/URM–25F set to 15,000 microvolts ±5,000. If this result is obtained, proceed to (15) below. If the normal result is not obtained, check V303 and T305. Check associated circuit components.

(15) Set output level of AN/URM–25F to 500 microvolts and connect red lead of cable from the signal generator to pin 1 of V302.

(16) A 500 microvolt ±180 output from the AN/URM–25F should produce the same reading on the ME–26/U as obtained in (12) above. If normal result is obtained, proceed to (17) below. If ME–26/U reading is low, tube V302 is weak. If no voltage is registered on ME–26/U, V302 or T304 is defective. Also check R307, R308, R310 and C309.

(17) Vary RF GAIN control counterclockwise and then return to full clockwise position.

(18) ME–26/U reading should decrease as RF GAIN is rotated counterclockwise and increase as control is returned to full clockwise position. If these results are not obtained, check R309 and R301 for open condition.

(19) Connect red lead from the AN/URM–25F test cable to pin 7 of V301 and set output of AN/URM–25F to 600 microvolts.

(20) A 600 microvolt ±210 output from the AN/URM–25F should produce the same output voltage on the ME–26/U as obtained in (12) above.

(21) If the result is not as specified in (20) above, V301 or T303 are likely defective or T303 is misaligned. Also check R304 and R305 for open condition and C306 for short. If voltage registered on ME–26/U is excessive, L307 or C302 is likely open.

(22) If the results specified in (12), (14), (16), (18) and (20) above are obtained, the second mixer, IF stages, and second detector in the receiver are good. Proceed to *e* below.

e. Oscillator Subassembly. Accomplishment of the following checks will determine whether the first oscillator section is operating properly. Perform the checks in the order listed.

Note. Allow test equipment approximately 30 minutes warmup time prior to use.

(1) Verify receiver POWER switch is set to OFF.

(2) Set receiver controls as follows: RF GAIN, AF GAIN, and AUDIO QUIETING DB controls to full clockwise position, SQUELCH switch OFF, NOISE LIMITER SWITCH ON.

(3) Set ME–26/U to monitor +3v dc. Connect COMMON test lead to receiver chassis ground, and DC test probe to pin 7 on V404.

(4) Set receiver POWER switch to ON and allow receiver a minimum of 30 minutes warmup time.

(5) ME–26/U should read approximately 1.5 volt (will vary slightly, depending on the frequency setting).

(6) Disconnect the ME–26/U from the receiver.

(7) Connect the AN/USM–207 to pin 2 of V404 via a coaxial cable. Connect the center conductor of the coaxial cable to pin 2 through a 1-μμf capacitor. Connect the shield of the coaxial cable to receiver chassis ground.

(8) The frequency count displayed on the AN/USM–207 should be equal to the operating frequency of the receiver minus 40.4 MHz ±10 kHz.

(9) If the specified results are obtained in (5) and (8) above, the first oscillator circuitry is functioning properly. Proceed to checks in *f* below.

(10) If the specified results are not obtained in (5) and (8) above, V504 or U502 is defective; check components of the oscillator subassembly second amplifier stage.

(11) Set ME–26/U to monitor negative 3v dc. Connect COMMON test lead to ground and DC test probe to 2ND AMPL METER jack J504.

(12) ME–26/U should read approximately 1 volt (will vary slightly depending on injection frequency).

(13) Connect AN/USM–207 to pin 1 of V504 using connection procedure described in (7) above. Frequency displayed by AN/USM–207 should be the same as specified in (8) above.

(14) If the specified results are obtained in (12) and (13) above, V501, V502, V503 and associated circuitry are good. Proceed to (15) below. If the correct results are not obtained, check V503 stage circuitry.

(15) Set ME–26/U to monitor –10v dc; connect DC test probe to 2ND TRIPL METER J503.

(16) ME–26/U should read approximately 3 volts. Reading will vary slightly depending on frequency.

(17) Connect AN/USM–207 to pin 1 of V503; make connections to the tube socket pin as detailed in (7) above.

(18) Frequency displayed on AN/USM–207 should be receiver channel frequency in MHz –40.4 MHz, divided by three, ±10 kHz.

(19) If the specified results are obtained in (16) and (18) above, V501, V502 and associated circuitry is good. If the specified results are not obtained, check V502 stage circuitry.

(20) Set ME–26/U to monitor –3v dc; connect DC test probe to 1ST AMPL METER jack J502.

(21) Reading displayed on ME–26/U should be approximately 1.5 volt. Reading will vary slightly depending on frequency.

(22) Connect AN/USM–207 to pin 1 of V502, using connection procedures described in (7) above.

(23) Frequency count displayed on AN/USM–207 should be as specified in (18) above.

(24) If specified results are obtained in (21) and (23) above, V501 and associated circuitry is good. If specified voltage is not obtained, check C513, R507, R508 for open condition, C502 for short condition and C508 and C512 for open or short condition.

(25) If frequency count displayed on AN/USM–207 drifts, check operation of crystal oven A501 as described in (26) and (27) below.

(26) Set ME–26/U to monitor 10v ac and connect AC test probe between pin 1 of oven socket and receiver chassis ground.

(27) ME–26/U should intermittently read 6.3v ac as thermostat in oven opens and closes. If reading remains zero, thermostat in oven is defective or discontinuity exists in line connecting voltage to pin 3.

(28) Set ME–26/U to monitor –3v dc. Connect COMMON test lead to ground and DC test probe to 1ST TRIPL METER jack J501.

(29) ME–26/U reading should be approximately 1 volt. Reading will vary slightly depending on frequency.

(30) Connect AN/USM–207 to pin 2 of V501, using connection procedures described in (7) above.

(31) Frequency count displayed on AN/USM–207 should be the fundamental frequency of the crystal ±10 kHz.

(32) If results specified in (29) and (31) above are obtained, V501 and associated circuitry is good. If specified results are not obtained, crystal Y501 or V501 is likely defective. Also check other stage components.

f. RF Section. Accomplish the following procedures when performing signal substitution tests of the RF section of the receiver:

Note. Allow test equipment and equipment under test approximataely a 1-hour warmup prior to performing tests.

(1) Verify receiver power switch is set to OFF. Set RF GAIN control full clockwise, AF gain control full clockwise, AUDIO GUIETING DB control full clockwise, SQUELCH switch OFF, NOISE LIMITER SWITCH to ON.

(2) Set AN/USM–44A to provide unmodulated output frequency at the channel center frequency of receiver to be tested.

(3) Connect output of AN/USM–44A to input of AN/USM–207, and verify that the output frequency is correct.

(4) Disconnect AN/USM–44A from AN/USM–207; connect output of AN/USM–44A to ANT. INPUT jack J401 on rear of receiver.

(5) Set output level of AN/USM–44A to 3 microvolts.

(6) Jumper J506 to receiver chassis ground to eliminate avc action.

(7) Set ME–26/U to –3v dc range; connect COMMON test lead to receiver chassis ground, and DC test lead to jack J304.

(8) Set receiver POWER switch to ON. Allow approximately 30 minutes warmup time.

(9) ME–26/U should read approximately 2.6 volts. If the correct reading is obtained, the rf circuitry in the receiver is good. If an abnormal indication is obtained, check V404, T301, and other stage components.

(10) Set ME–26/U to 3v ac range. Connect AC test probe between pin 1 of V404 and receiver chassis ground.

(11) Set output level of AN/USM–44A to 500 millivolts.

(12) ME–26/U reading should vary from 0.6V at 225 MHz to 2.8 volts at 399.9 MHz.

(13) If voltage reading is low, V403 is weak, U404 is misaligned or C421 is open. If voltage output is high, C433 or R420 is open or C415 or C416 is shorted. If no voltage output is available, V403 or U404 is defective, C423 is open or shorted, C421 or C433 is shorted. L403, R409, R410, R411 and R414 should also be checked for an open condition.

(14) Set ME–26/U to 10v ac range. Connect AC test probe across pin 1 of V403 and receiver chassis ground.

(15) ME–26/U should vary from as high as 3.1 volts at 225 MHz to as low as 1.4 volt at 399.9 MHz.

(16) If voltage reading is low, V402 is weak, U403 is misaligned or C409 is open. If voltage reading is high, C409 is shorted or C413 is open. If no output is available, V402 or U403 is defective, C413 is shorted or C412, C414, L402, R406 or R407 is open.

(17) Set ME–26/U to 3v ac range and connect AC test probe between pin 2 of V202 and receiver chassis ground.

(18) Reading on ME–26/U should vary from as high as 2.0 volts at 225 MHz to as low as 0.9 volt at 399.9 MHz.

(19) If voltage reading is low, V401 is weak, U402 is misaligned or C402 is open. If voltage reading is high, C402 is shorted. If no voltage output is available, V401 or U402 is defective, C406, C407, L401, R403 or R404 is open, or C406 is shorted.

(20) Set ME–26/U to 1v ac range; connect AC test probe across pin 2 of V401 and receiver chassis ground.

(21) Reading on ME–26/U should read approximately 0.3 volt. Low or no voltage output indicates poor or shorted connection at ANT. INPUT jack J401, or defective or misaligned U401.

(22) Remove the jumper from J304 to ground.

3–11. Voltage and Resistance Checks

Warning: **Voltages dangerous to life are present in the receiver when it is energized. Be careful when performing voltage measurements. Verify that power is removed from the receiver prior to performing resistance checks.**

a. A voltage and resistance diagram for the receiver is presented in figure 3–2. The figure indicates the values that should be obtained when performing measurements from the tube socket pins to chassis ground. Conditions should be as specified in figure 3–2 when making measurements for comparison to those listed on the figure.

b. Voltage and resistance measurements normally should be performed only after an operational test (para 3–9), or signal substitution tests, (para 3–10), has isolated trouble to a particular stage in the defective receiver.

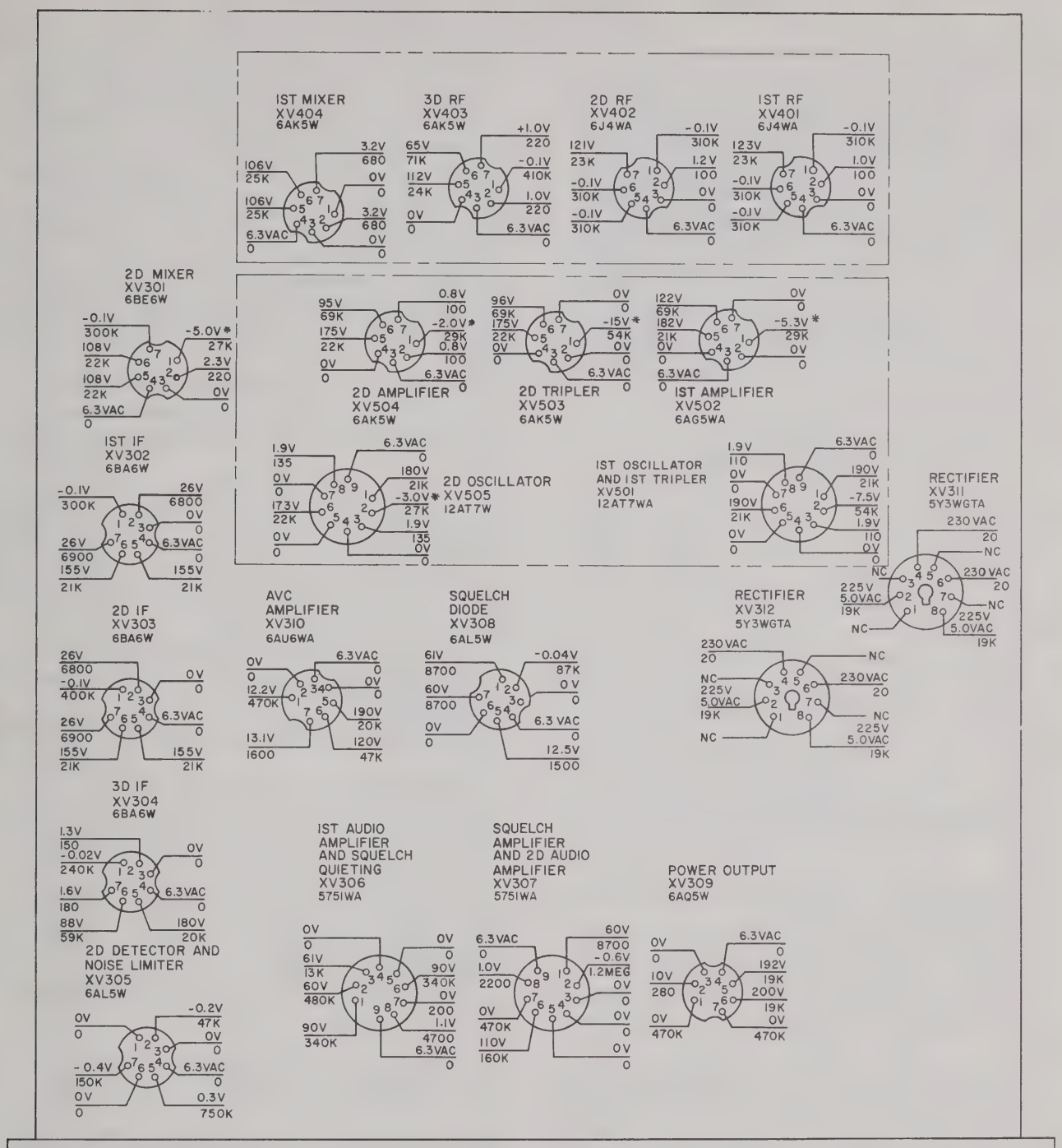
c. Use an ME–26/U or equivalent when making the measurements. If a measurement varies beyond a reasonable limit from the value listed, record the difference. Refer to the receiver schematic diagram and use the discrepancy as an aid in isolating the defective components. Figure 5–1 contains resistor and capacitor color code charts.

3–12. Troubleshooting Chart

The following troubleshooting chart is supplied as an aid in identifying the most likely cause of defective receiver operation. The receiver schematic diagram (fig. 5–2), voltage and resistance checks (para 3–11) and signal substitution tests (para 3–10) should be used in conjunction with the troubleshooting chart in isolating the cause of defective operation.

Item No.	Symptom	Probable cause	Corrective action
1	Ac line fuse F301 continues to open when replaced.	*a.* Power input circuitry defective	*a.* Perform procedures in (para 3–8*a*) to isolate defective circuitry.
		b. Short in filament circuit	*b.* Perform procedures in (para 3–8*b*) to isolate short.
2	B+ line fuse F302 continues to open when replaced.	Short in B+ circuitry	Perform procedures in (para 3–8*c*) to isolate short.
3	Audio output level varies greatly during operation.	Avc circuit defective	Perform procedures in (para 3–10*d*) to determine whether the IF circuitry is operating properly. If IF circuitry is good, check V308 and V310. If necessary, perform voltage and resistance measurements (para 3–11) to isolate defective component in avc circuitry.
4	Frequency drift	Faulty crystal oven A501	Check oven operation as described in paragraph 3–10*e*(26) and (27). Replace oven if defective (para 3–18*b*).
5	No audio output available for large signal input and AUDIO QUIETING DB control in full counterclockwise position; reduce audio output available when AUDIO QUIETING DB control rotated clockwise.	Squelch circuit defective	Perform those procedures in paragraph 3–9 necessary to isolate trouble to components in squelch circuitry.

Item No.	Symptom	Probable cause	Corrective action
6	No audio output available when signal is applied to receiver input but audio output is available when modulated 6 MHz signal is applied to IF circuitry.	Defective RF or oscillator circuitry.	Perform signal substitution checks (para 3–10*e* and *f*) to localize trouble to RF or oscillator circuitry. Check, and if necessary, replace defective tube or crystal. If necessary, use voltage and resistance checks, (para 3–11), to isolate defective component.
7	No audio output available when test signal (para 3–10*d*) is applied to IF circuitry but normal voltage available at output of second detector and noise limiter.	Audio amplifier circuitry defective.	Perform signal substitution test (para 3–10*c*) to localize trouble to defective stage. Check tube in defective stage and replace if necessary. If necessary, perform voltage and resistance measurements (para 3–11) to isolate defective component.
8	Excessive noise in receiver output when input signal is too weak to overcome squelch action and AUDIO QUIETING DB control fully counterclockwise.	Squelch circuit defective	Check, and if necessary, replace V307 and V308. If necessary, perform voltage and resistance measurements (para 3–11) to isolate defective component.
9	Audio output low	*a.* V306 or V309 weak or defective component in audio amplifier circuitry.	*a.* Check, and if necessary, replace V306 or V309. Perform voltage and resistance measurements (para 3–11) to isolate defective component.
		b. Receiver misaligned	*b.* Check receiver alignment (sec. III).
10	Receiver output excessively noisy for high level input.	*a.* Poor antenna connection or antenna damaged.	*a.* Short J401 to ground. Considerable decrease in noise isolates malfunction to antenna input. Check antenna cable connection at input to receiver and antenna takeoff. Check antenna for excessive corrosion or other evident damage.
		b. Defective V306 or V309	*b.* Tap lightly on V306 and V309 with insulated prod. If tapping causes noise in output, replace tube.
11	Distorted audio output	V306 or V309 defective or not biased properly.	Check V306 and V309 by substitution. Check voltage and resistance readings (para 3–11).



NOTES:

1. ALL VOLTAGE MEASUREMENTS WERE MADE UNDER THE FOLLOWING CONDITIONS:
   (A) THE VOLTAGE SUPPLY AT 115V AT 60 HZ.
   (B) NO RF SIGNAL INPUT.
   (C) THE "AUDIO QUIETING DB" CONTROL IN THE EXTREME COUNTERCLOCKWISE POSITION.
   (D) THE "R.F. GAIN" CONTROL IN THE EXTREME COUNTERCLOCKWISE POSITION.
   (E) THE "A.F. GAIN" CONTROL IN THE EXTREME COUNTERCLOCKWISE POSITION.
   (F) THE NOISE LIMITER SWITCH IN THE "ON" POSITION.
   (G) THE "SQUELCH" SWITCH IN THE "OFF" POSITION.
2. ALL VOLTAGES DC EXCEPT WHERE NOTED.
3. ALL VOLTAGES MEASURED WITH RESPECT TO GROUND, EXCEPT THE FILAMENTS ON V311 AND V312.
4. * INDICATES APPROXIMATE VOLTAGE. ACTUAL VOLTAGE DEPENDENT ON CRYSTAL ACTIVITY, MUTUAL CONDUCTANCE OF V501, V502, V503, V505, AND CHANNEL (FREQUENCY) IN USE.
5. RESISTANCE MEASUREMENTS WERE MADE WITH POWER SWITCH SET TO OFF, REMAINING CONTROLS SET AS SPECIFIED IN IC THROUGH G.
6. RESISTANCE VALUES MEASURED WITH RESPECT TO CHASSIS GROUND.
7. VOLTAGES ARE ABOVE THE LINE, RESISTANCE VALUES BELOW THE LINE.
8. NC INDICATES NO CONNECTION.
9. MEASUREMENTS MADE WITH METER, VOLT, ME-26/U.

TM5820-735-35-7

Figure 3-2. Tube socket voltage and resistance diagram.

Section III. ALIGNMENT AND ADJUSTMENT

3–13. General

This section provides procedures necessary to align the oscillator and RF and IF sections of the receiver. The alignment procedures should be accomplished whenever the operating channel frequency is changed, or whenever maintenance results in replacement of parts in the oscillator and RF or IF sections of the receiver. In addition, alignment should be checked whenever defective receiver operation cannot be traced to a faulty component. Perform the procedures in the order indicated when accomplishing overall alignment of the receiver.

3–14. Alignment of IF Section, Avc Circuit, and Second Oscillator (figs. 3–3 and 3–4)

Accomplish the following procedures when aligning the IF section, avc circuit, and second oscillator sections of the receiver.

a. Place the receiver on a workbench and remove the dust cover.

b. Verify that receiver POWER switch is set to OFF and connect power cord between receiver and 115V or 230V, 50 to 60 Hz power source as applicable.

c. On receiver, set RF GAIN control fully clockwise, AUDIO QUIETING DB and AF GAIN controls fully counterclockwise, SQUELCH switch to OFF, and NOISE LIMITER SWITCH to OFF.

d. Connect a short lead from J506 to receiver chassis ground; this disables avc.

e. Set ME–26/U to monitor negative 10v dc.

f. Connect ME–26/U COMMON lead to receiver chassis ground. Do not change this connection until alignment procedures have been completed.

g. Connect ME–26/U DC test probe to J304.

h. Solder or clip a 680-ohm resistor across the primary of T303.

i. Connect the output of the AN/URM–25F to the input of the AN/USM–207.

j. Set controls on AN/URM–25F to provide an unmodulated output of exactly 6 MHz as displayed on the AN/USM–207.

k. Disconnect the AN/URM–25F from the AN/USM–207 and connect the output of the AN/URM–25F to the center tab of C351 (or pin 7 of V301).

l. Set receiver POWER switch to ON and allow receiver 20 minutes warmup time.

m. Adjust the output level of the AN/URM–25F to obtain a nominal reading on the ME–26/U.

n. Tune the secondary slug of T303 (top of shield can) to obtain maximum indication on the ME–26/U.

o. Set receiver POWER switch to OFF, disconnect the 680-ohm resistor from the primary of T303 and temporarily connect the resistor across the secondary of T303.

p. Set the receiver POWER switch to ON.

q. Tune the primary slug of T303 (bottom of chassis) to obtain maximum indication on ME–26/U.

r. Set the receiver POWER switch to OFF.

s. Disconnect the 680-ohm resistor from the secondary of T303 and connect across primary of T304.

t. Set the receiver POWER switch to ON and tune secondary slug of T304 to obtain maximum reading on ME–26/U.

u. Set the receiver POWER switch to OFF, disconnect resistor from primary of T304 and connect across secondary of T304.

v. Set the receiver POWER switch to ON and tune primary of T304 to obtain maximum reading on ME–26/U.

w. Repeat *r* through *v* above for T305 and T306.

x. Remove the jumper from J506.

y. Insert ME–26/U DC test probe in J303.

z. Tune T302 slug (botton of chassis) to obtain maximum indication on ME–26/U.

aa. Insert ME–26/U DC test probe in J505.

ab. Tune the 2ND OSC. TUNING control to obtain maximum reading (3.5 to 5 volts).

ac. Disconnect ME–26/U and AN/URM–25F from the receiver.

3–15. Alignment of First Oscillator Section (fig. 3–3)

Accomplish the following procedures when aligning the first oscillator section of the receiver. Perform the procedures in the order listed.

Note. Allow the ME–26/U approximately 30 minutes warmup prior to use. Verify that meter is calibrated before using.

a. Place the receiver on workbench where 115 or 230v ac, as applicable, is available and remove the receiver dust cover.

b. Verify that the proper crystal Y501 is in place in crystal oven A501; if not, install the proper crystal (para 3–18).

c. Verify the receiver power switch is set to OFF and connect ac power cord between the receiver and the power source.

d. Set the receiver POWER switch to ON and allow a 1-hour warmup.

e. Set ME–26/U to monitor –10v dc.

f. Connect the ME–26/U COMMON lead to the receiver chassis ground.

g. Insert the ME–26/U DC test probe in 1ST TRIPL METER jack J501 and tune 1ST OSC control to obtain a peak reading on the ME–26/U.

h. Insert the ME–26/U DC test probe in 1ST AMPL METER jack J502 and tune the 1ST TRIPL PLATE control to obtain a peak reading on the ME–26/U.

i. Insert the ME–26/U DC test probe in 2ND TRIPL METER jack J503 and tune the 1ST AMPL PLATE control to obtain a peak reading on the ME–26/U.

j. Insert the ME–26/U DC test probe in 2ND AMPL METER jack J504 and tune the 2ND TRIPL PLATE control for a peak reading on the ME–26/U.

k. Disconnect ME–26/U from the receiver.

3–16. RF Alignment

a. The RF alignment procedures listed below should be accomplished only after completion of the alignment procedures outlined in paragraphs 3–14 and 3–15.

b. Alignment controls are located in figures 3–3 and 3–4. Accomplish the procedures below in the order listed when aligning the RF section of the receiver.

(1) With the receiver on a workbench and the dust cover removed, connect equipment as described below. Allow test equipment approximately 30 minutes warmup time and verify calibration of the test equipment prior to use.

(2) Verify the receiver POWER switch is set to OFF. Set the other receiver controls as follows: RF GAIN control fully clockwise, AUDIO QUIETING DB and AF GAIN controls fully counterclockwise, SQUELCH switch to OFF, and NOISE LIMITER SWITCH to OFF.

(3) Set the receiver ANT, 1ST RF PLATE, 2ND RF PLATE and 3RD RF PLATE tuning controls as near the desired operating frequency as possible.

(4) Set ME–26/U as required to monitor –10v dc.

(5) Connect the COMMON test lead of ME–26/U to ground and DC test probe to J304.

(6) Connect a jumper from J506 to the receiver chassis ground to eliminate avc action.

(7) Set the receiver POWER switch to ON and allow 1 hour warmup time.

(8) Set the controls on AN/USM–44A as required to supply an unmodulated output frequency equal to the receiver channel center frequency.

(9) On the AN/USM–44A, set the AMP. TRIMMER control fully clockwise and OUTPUT LEVEL control as required to adjust the pointer on the OUTPUT VOLTS meter to SET LEVEL point (red line).

(10) Set the output attenuator on AN/USM–44A fully counterclockwise.

(11) Connect the output of AN/USM–44A to input of AN/USM–207 and verify that the output frequency of AN/USM–44A is correct.

(12) Disconnect AN/USM–44A from AN/USM–207 and connect the output of AN/USM–44A to ANT. INPUT jack J401 through the 6-db attenuator pad supplied with the signal generator.

(13) Adjust the output level of the AN/USM–44A to obtain a low reading on ME–26/U.

(14) Tune ANT alignment control to obtain peak reading on ME–26/U.

(15) Tune 1ST RF PLATE alignment control to obtain peak reading on ME–26/U.

(16) Tune 2ND RF PLATE alignment control to obtain peak reading on ME–26/U.

(17) Tune 3RD RF PLATE alignment control to obtain peak reading on ME–26/U.

(18) Tune 2ND AMPL PLATE alignment control to obtain peak reading on ME–26/U.

(19) Tune secondary of T301 (top slug) to obtain peak reading on ME–26/U.

(20) Tune primary of T301 (bottom slug) to obtain peak reading on ME–26/U.

(21) Tune L307 to obtain peak reading on ME–26/U.

(22) Repeat (14) through (21) above. Disconnect jumper and test equipments when alignment is completed.

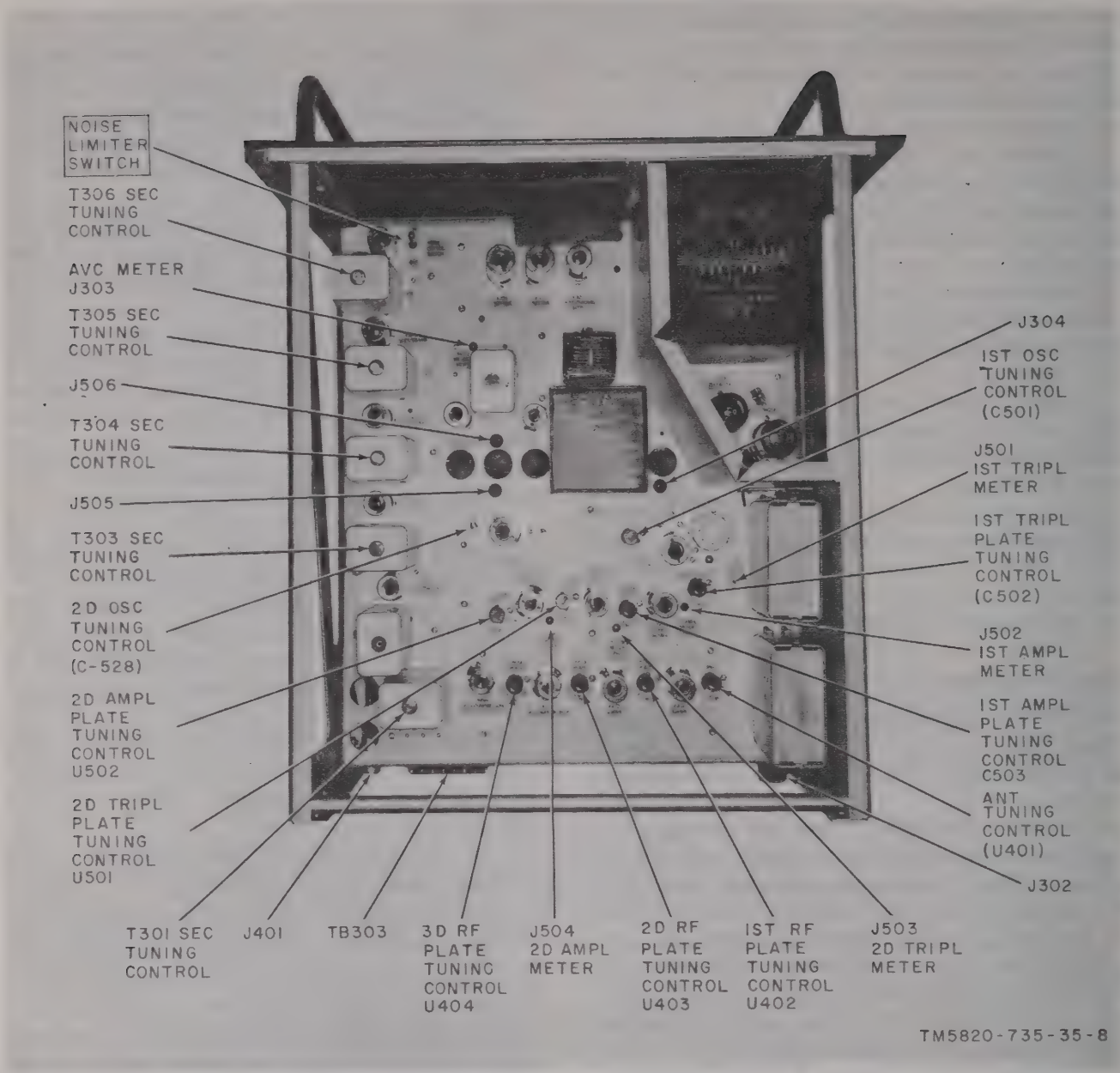


Figure 3-3. Receiver alignment controls and jacks, top view.

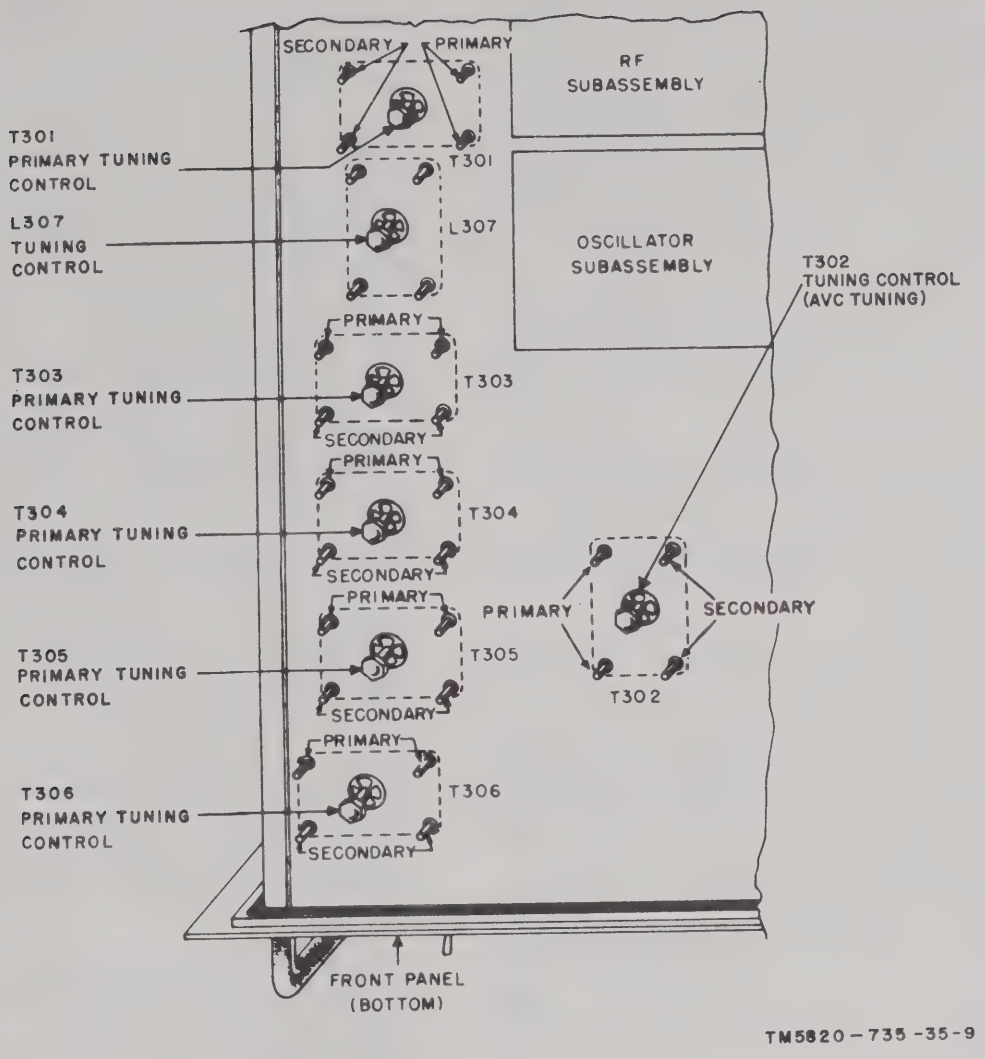


Figure 3–4. Receiver alignment controls, bottom view.

Section IV. REPAIR, REMOVAL, AND REPLACEMENT

3–17. General

Repair, removal and replacement at the direct support maintenance category encompasses repair and replacement of all electronic components necessary to return a defective receiver to operation. Spare parts normally stocked at the direct support category are listed in TM 11–5820–201–35P. Location of components in the receiver is shown in figures 3–6 through 3–11. In addition, figure 5–3, a wiring diagram of the receiver, depicts component location. Most components, as indicated in the referenced figures, are easily accessible for replacement. However, shields which cover the bottom of the oscillator and RF subassemblies must be removed to gain access to components located in these subassemblies. In addition, each of these subassemblies may be removed from the main chassis if desired. Instructions for accomplishing these actions are furnished in the following paragraphs. Instructions for installation of crystal Y501 in crystal oven A501, removal and replacement of the receiver dust cover, tube shields, and tubes are also included.

3–18. Installation of Crystal Y501

a. Crystal Y501 is located in crystal oven A501 to maintain the crystal at a constant temperature in order to prevent frequency drift. The following formula must be used when selecting the proper crystal for a desired operating frequency: Crystal frequency (in MHz) = 1/9 (channel frequency (in MHz) –40.4 MHz).

b. Accomplish the following procedures when installing the crystal. If a crystal is being installed to change the channel frequency of the receiver or to replace a defective crystal, perform the receiver RF and oscillator alignment procedures presented in paragraphs 3–15 and 3–16.

(1) Place the receiver on a workbench and remove the dust cover.

(2) Remove crystal oven A501 (fig. 3–7) from its mounting socket in the receiver.

(3) Loosen the three screws securing the metal cover of the oven to the bakelite base.

(4) Rotate the metal can counterclockwise to unlock and lift it up and away from the bakelite base.

(5) Remove the two screws that secure the heat conductor to the heater assembly, and remove the heat conductor.

(6) If the oven contains a crystal, remove it by grasping firmly and pulling straight up.

(7) Align the mounting pins of the new crystal in place over the mounting receptacles and insert firmly in place.

(8) Position the heat conductor in place and secure with the two screws removed in (5) above.

(9) Insert the metal cover over the heater assembly and position it so that the slots fit over screws on bakelite base.

(10) Rotate the metal cover slightly clockwise to lock in place and tighten the three screws that secure the metal cover to the bakelite base.

(11) Insert the oven in its mounting socket on the receiver.

3–19. Removal and Replacement of Receiver Dust Cover

Removal and replacement of the dust cover is accomplished as follows.

a. Remove all cables connected to the rear of the receiver.

b. Depress and rotate each of the four twistlock fasteners on the rear of the dust cover 1/4 turn counterclockwise to disengage.

c. Pull the dust cover straight back and off the rear of the receiver.

d. When replacing the dust cover, remove all cables from the rear of the receiver.

e. Carefully position the dust cover so that it fits over the rear of the receiver and push forward until the dust cover fits snugly against the back of the receiver front panel.

f. Depress each of the four twistlock fasteners and turn 1/4 turn clockwise to engage.

3–20. Replacement of Tubes

Many electron tubes are needlessly discarded as faulty. To reduce this waste of material, repair personnel concerned should use the information in *a* through *j* below as a guide when replacing tubes:

a. Do not discard tubes merely because the tubes have been in use for a specified period of time. Satisfactory operation in a circuit is the final proof of tube quality. The tube in use may work better than a new one.

b. Do not discard tubes merely because they fall on or slightly below the minimum acceptable value when checked in a tube checker. It must be recognized that a certain percentage of new tubes fall near the low end of the acceptability range of the tube specification. Therefore, these tubes start their operational life at a value fairly close to the tube tester retention limit. These tubes may provide satisfactory performance throughout a long period of operational life at this near-limit value. Substitute new tubes only for those actually defective or when the new tube returns the equipment to operation.

c. Discard tubes only when a test in a tube tester or other instrument shows that the tube is absolutely defective or if the tube defect is obvious, *for example*, if the glass envelope is broken, the filament is open, or a connecting prong or lead is broken.

d. Unless the tube defect is obvious, isolate trouble to a specific stage of the equipment before removing tubes in operation.

e. If a tube tester is used, remove and test one tube at a time.

f. If a tube tester is not available, check by tube substitution as follows:

(1) Replace suspect tubes, one at a time, while observing equipment operation. Note the socket from which each tube is removed. If the equipment becomes operative, discard the last tube removed.

Note. Some circuits, such as oscillator circuits, may function with one tube and not another, even though both tubes are new. If practicable, retain any removed tube until it can be checked in a tube checker.

(2) Reinsert the remaining original tubes, one at a time, in the original sockets. If equipment failure occurs, discard the last inserted original tube and replace with a new one.

g. If a replacement for a bad tube soon becomes defective, check the adjustment and condition of component parts of the particular stage; otherwise, continued tube replacement will effect only

temporary repair and more serious trouble may result.

h. All tubes with the exception of V309, V311 and V312 are covered by metal shields. Proceed as follows when replacing the tubes.

(1) Set the receiver POWER switch to OFF.

Caution: **Tubes and tube shields will remain hot for a short period of time subsequent to turn off of receiver. Exercise caution to prevent burns.**

(2) Press down gently on tube shield, turn counterclockwise to unlock, and lift off.

(3) Pull tube straight up and out of its mounting socket. If tubes do not release easily, rock gently and then pull upward.

(4) Align pins of a new tube to mate correctly with socket connectors.

(5) Insert tube gently into socket to prevent bending pins.

(6) Insert tube shield over tube insuring that the shield is positioned properly.

(7) Push shield straight down and turn slightly clockwise to secure in place.

i. Tube V309 is held in place by a Birtcher (hat) clamp. Replace this tube as outlined in *h* above except raise the lid of the clamp and rotate 90 degrees. After inserting new tube, lift the lid of the clamp and rotate until it clamps in place over the new tube.

j. Tubes V311 and V312 are held in place by retainer rings. The retainers are removed as follows.

(1) Place index finger on top of the threaded rod and the thumb on the outer edge of the ring tab.

(2) Press thumb and index finger together, and lift the retainer up and off the threaded rod.

(3) When replacing the retainers, place the hole in the tab over the threaded rod.

(4) Apply pressure downward at the spot where the tab joins the ring.

(5) The retainer ring will now slide down the threaded rod. Continue to exert pressure until the ring fits snugly over the tube.

3–21. Replacement of Parts Other Than Tubes

Standard electronic shop procedures will provide satisfactory replacement of components in the receiver. The following general procedures should be adhered to when replacing components.

a. Replace a component with either an identical or equivalent component. Components in the RF and oscillator subassemblies must be the same both in physical size as well as electrical value, since in some cases differences in physical size may adversely affect circuit operation.

b. Physical orientation of replaced parts should conform to that of the removed part.

c. When removal of a part results in loose leads, or when a part with multiple leads is to be removed, tag the leads to identify the point they will be connected to after installation of the new part.

d. Use good heat sink procedures both during removal and replacement to prevent damage to other components in the circuit and to the new part.

e. Do not permit drops of solder to fall into receiver circuitry during soldering operations.

f. After a new part has been soldered in place, allow the connection to cool and verify that a good solder connection has been obtained.

3–22. Replacement of Parts in the RF and Oscillator Subassemblies

To reach parts in the RF and oscillator subassemblies on the bottom of the chassis, the shield covering the applicable assembly must be removed. Both of the shields are removed and replaced in the same manner, as outlined below.

a. Remove the grounding strap that connects the two shields by removing the two screws securing the strap.

b. Remove the screws and lockwashers at each of the four corners of the shield.

c. Lift the shield up and off the subassembly.

d. When replacing the shield, position properly over the subassembly and secure in place with the hardware items removed in *b* above.

e. Replace the connecting ground strap removed in *a* above.

3–23. Removal of RF and Oscillator Subassemblies (fig. 3–5)

The oscillator subassembly may be removed from the main chassis by accomplishing the procedures in *b* below. The RF subassembly may be removed by accomplishing the procedures in *a* below. Replacement is accomplished by reversal of the applicable removal procedures. The subassemblies have interconnecting wires; therefore, it is necessary to remove the shields from both subassemblies (para 3–22) and disconnect the interconnecting wires before either subassembly can be removed.

a. Accomplish the following procedures when removing the RF subassembly. (*See also* instructions on fig. 3-5).

(1) Remove the tube shield sockets over V403 and V404 by loosening or removing the screws holding the sockets to the main chassis.

(2) Detach ANT. INPUT jack J401 by removing nuts, screws, and lockwashers (four of each) holding jack and grounding fingers to rear of chassis.

(3) Detach cable clamp, on cable connected to J401, by removing nut, screw, flat washer, and lockwasher.

(4) Remove bracket shield from bottom of T301. One side is held in place with a lockwasher and nut, the other side with a lockwasher and screw.

(5) Unsolder a total of seven leads from the five center tabs on feedthrough capacitors. Make a sketch indicating color coding of wires and location of terminals to insure correct replacement.

(6) Remove the connecting grounding strap between RF and oscillator subassemblies. Remove cover, held by screws and lockwashers at each of the four corners of the subassembly.

(7) Unsolder the "connecting lead" from the terminal post in the RF subassembly. The lead is from U502 in the oscillator subassembly.

(8) From top of chassis, remove screws and lockwashers, at each of the four corners, and carefully lift out the RF subassembly.

b. Accomplish the following procedures when removing the oscillator subassembly:

(1) Remove the three tube shield sockets over V502, V503, and V504 by loosening or removing three screws.

(2) Remove the connecting grounding strap between the RF and oscillator subassemblies. Remove the cover, held by screws and lockwashers at each of the four corners of the subassembly.

(3) Unsolder the "connecting lead" from terminal post in RF subassembly. Lead is from U502 in oscillator subassembly.

(4) Unsolder the brown and red leads on RF subassembly. Make a sketch indicating color coding of wires and location of terminals in order to insure correct replacement.

(5) Unsolder the green lead from the terminal post supporting L507 near tube socket XV507.

(6) From top of chassis, remove screws and lockwashers, each of four corners, and one screw and lockwasher near filter choke L305. Remove two screws, nuts, and lockwashers located approximately 1 inch from and in line with two of the 4 screws.

(7) Lift the assembly up and out of the chassis.

3-24. Repair

The only components in the receiver which can be economically repaired are tuning capacitors C501, C502, C503, and C528 and tuning units U401, U402, U403, U404, U501 and U502. All other defective components must be replaced. Perform the procedures in *a* below when repairing tuning capacitors and those in *b* below when repairing tuning units.

a. Repair of Tuning Capacitors. Accomplish the following procedures when repairing tuning capacitors:

(1) Set the receiver POWER switch to OFF.

(2) Carefully bend any rotor plates which touch stator plates until the plates no longer touch. Use a sharp instrument such as a knife blade or small screwdriver to perform the bending action.

(3) Rotate the capacitor tuning shaft to check maximum, then minimum, meshing of the plates. Verify that rotor and stator plates do not touch in any position.

(4) Align the section of the receiver in which the capacitor is located, using procedures in section III.

b. Repair of Tuning Units. If a short circuit occurs between the rotor plates and the one turn silver-plated inductance on one of the tuning units (U401 through U404, U501 and U502), accomplish the following procedures to remove the short:

(1) Set the receiver POWER switch to OFF.

(2) Carefully bend the strap inductance outward until the rotor can be turned to furnish maximum to minimum capacitance without touching the inductance strap.

(3) Align that section of the receiver in which the tuning unit is located, using the procedures in section III.

3-25. Retropicalization After Repairs

All components located on the bottom of the receiver chassis with the exception of tuning capacitors, resistor R341, A.F. GAIN and AUDIO QUIETING DB potentiometers R327 and R333, SQUELCH and NOISE LIMITER switches S302 and S303, and jack J301 initially received moisture and fungus proof treatment. Therefore, any replaced, rewired, or resoldered components, with the exception of those listed above, should be

treated with TUF-ON-74 MFP varnish or equivalent. Treatment is accomplished as follows:

a. Thoroughly clean and dry the area or component(s) to be treated.

b. Brush on the MFP varnish with a clean brush.

c. Allow sufficient drying time so that treated area is not sticky to touch.

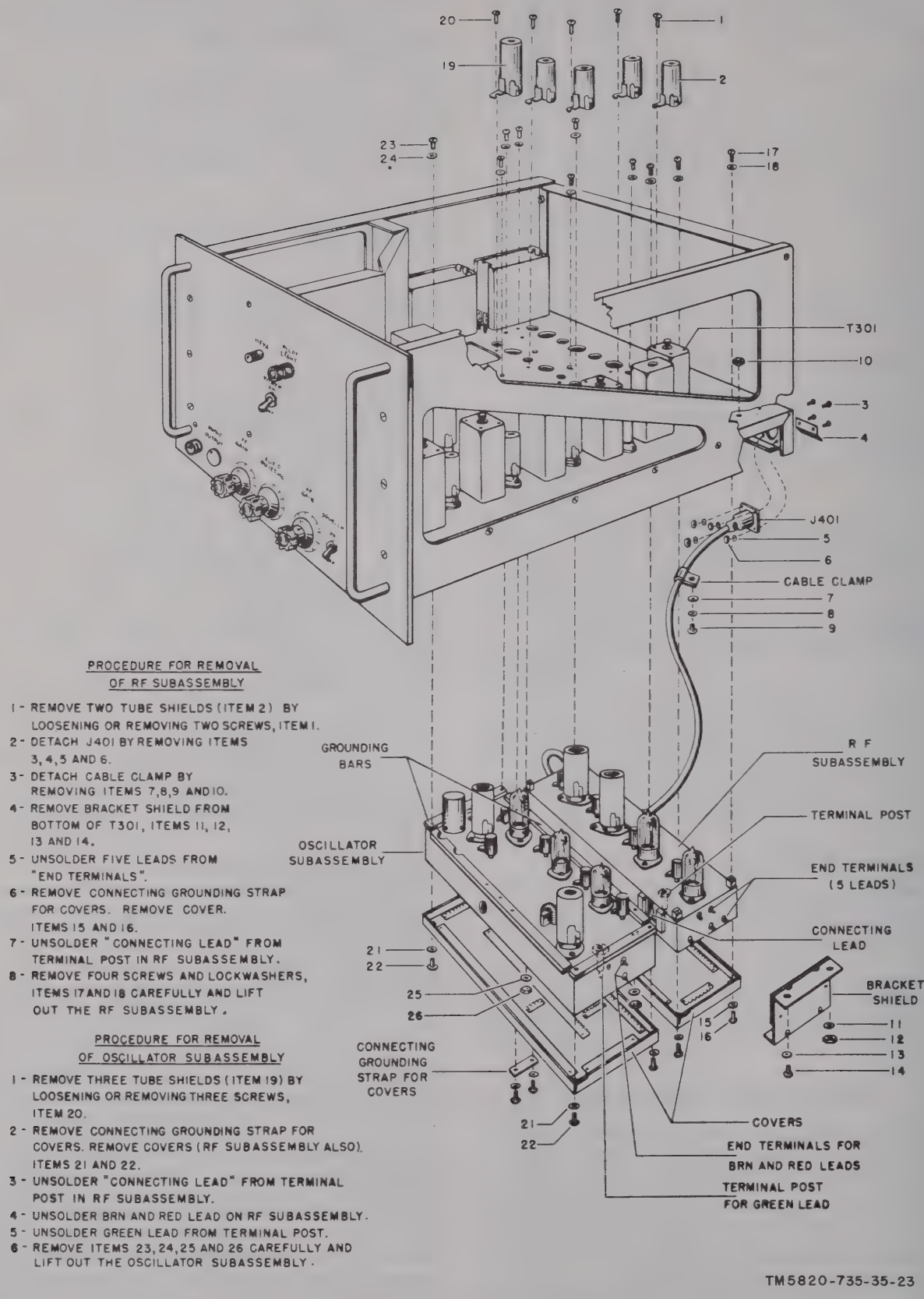


Figure 3-5. Removal of oscillator and RF subassemblies.

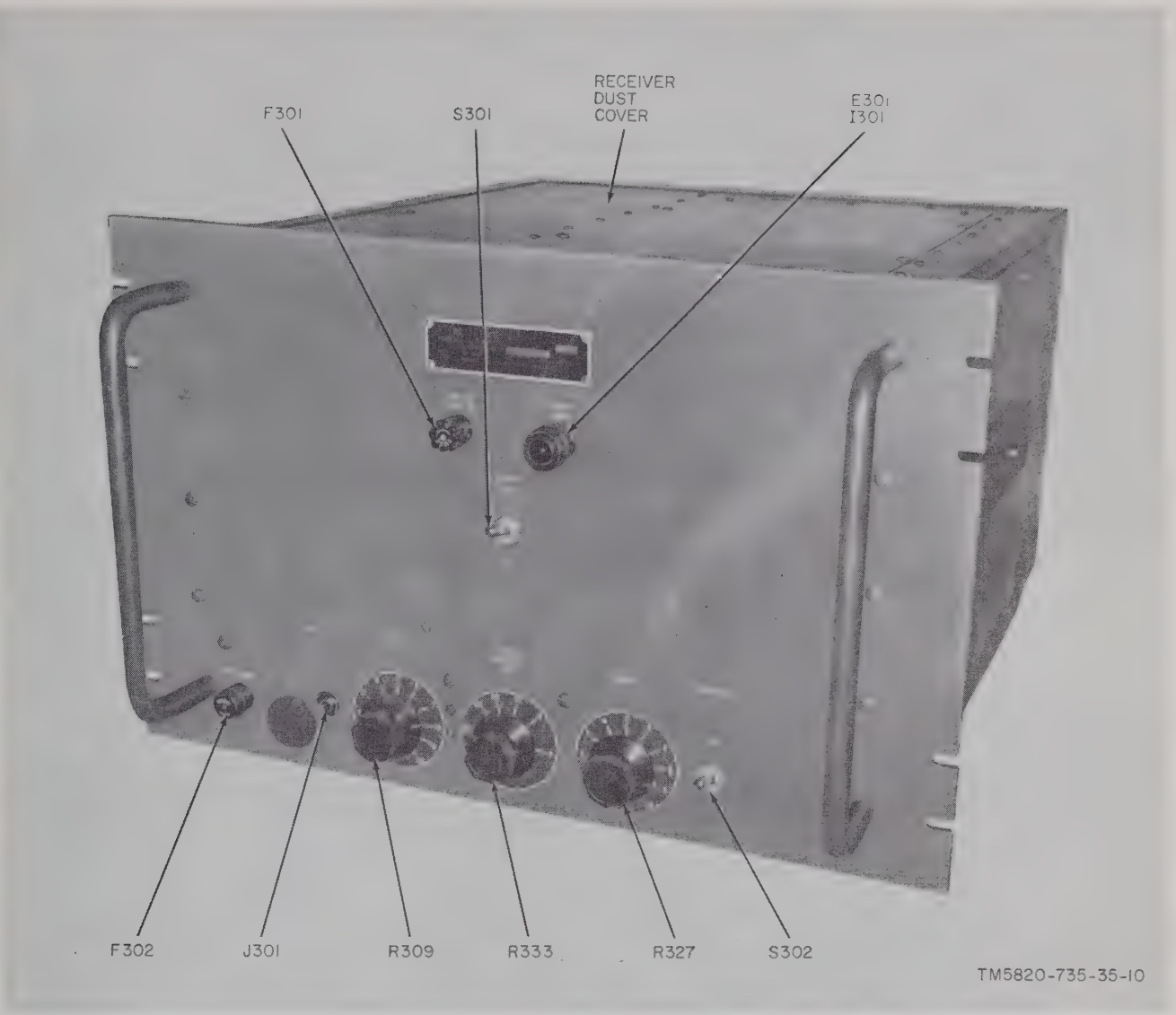


Figure 3–6. Parts location, front view.

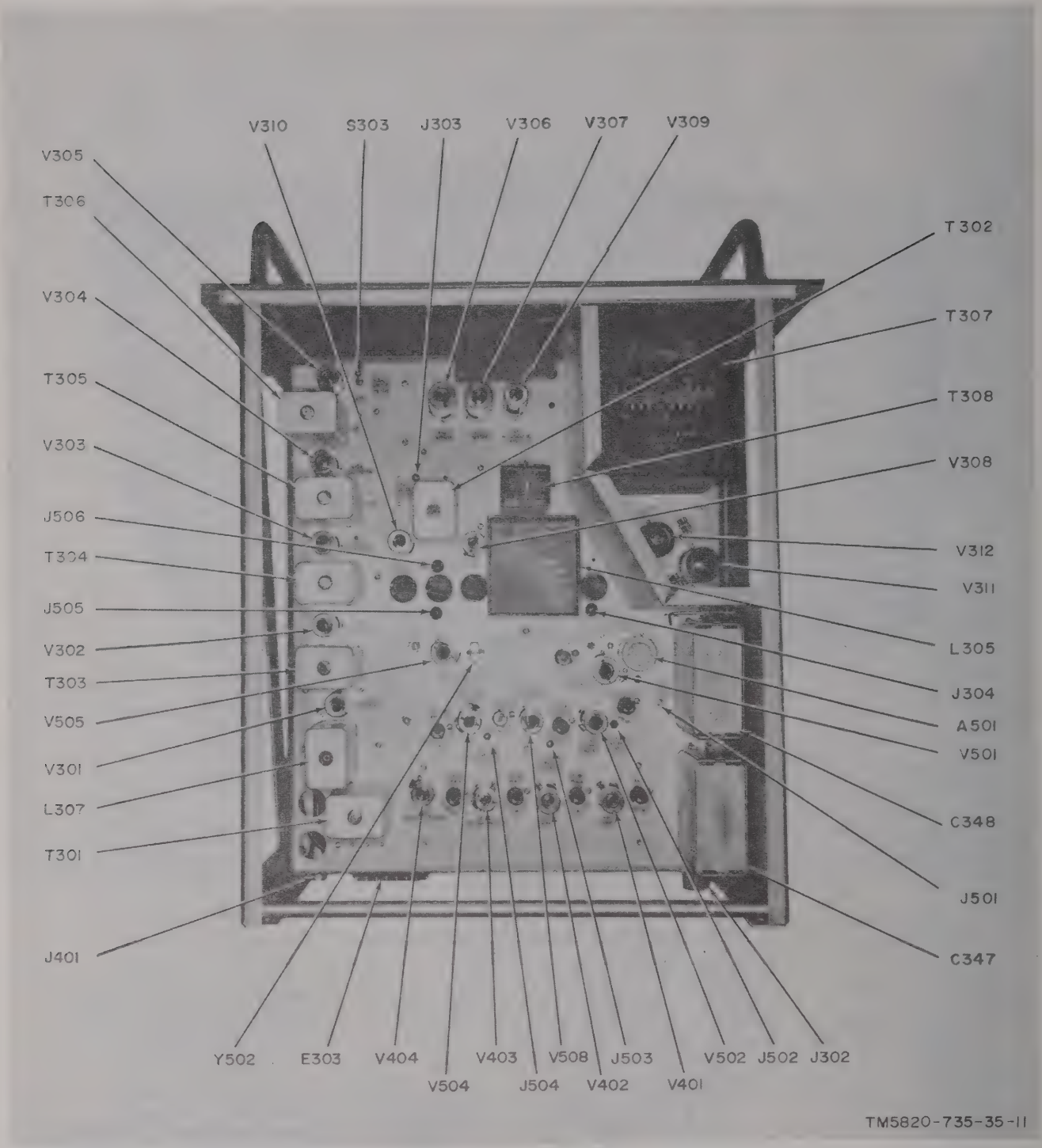


Figure 3-7. Parts location, top view.

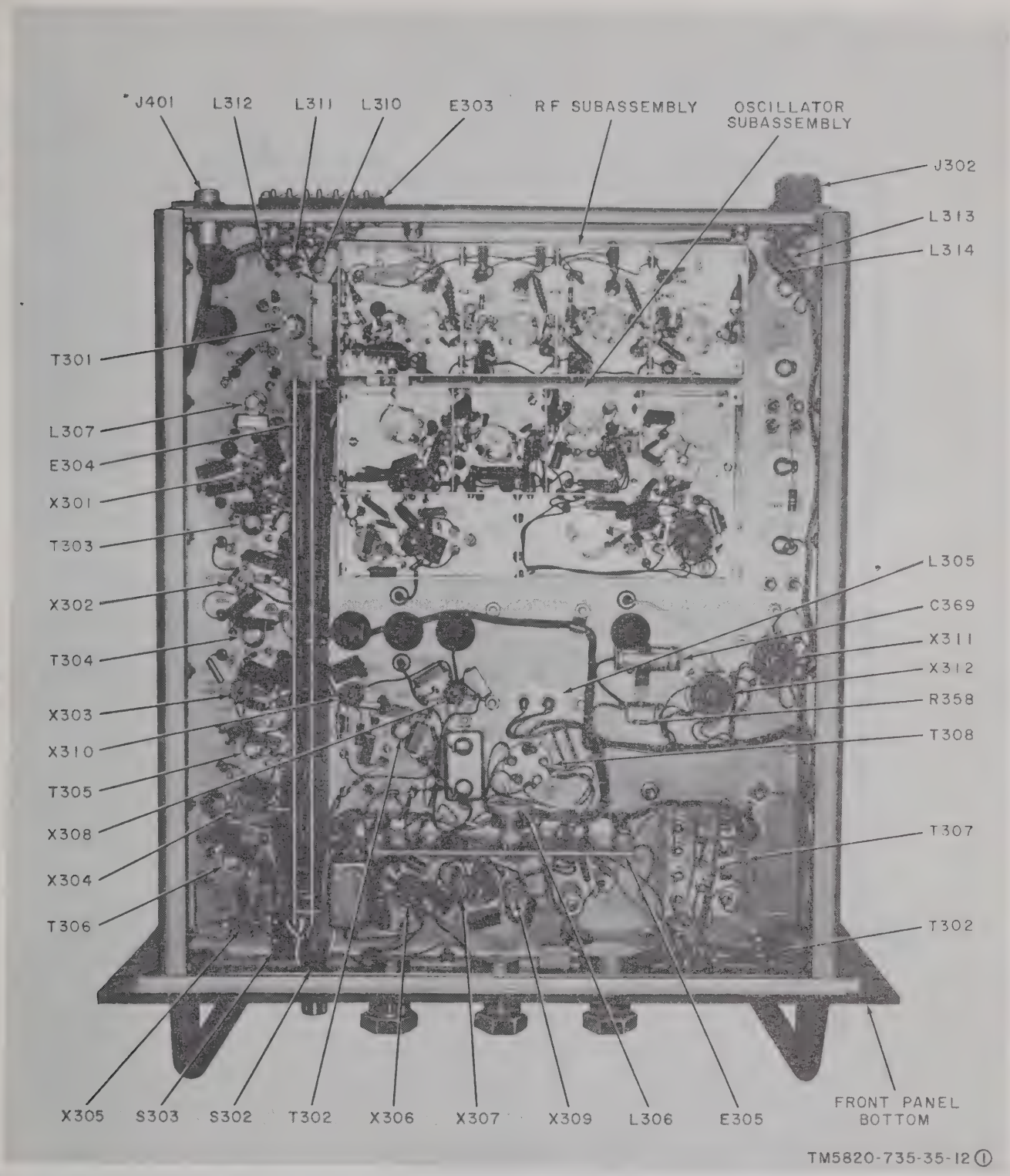


Figure 3–8(1). Parts location, bottom view (part 1 of 3).

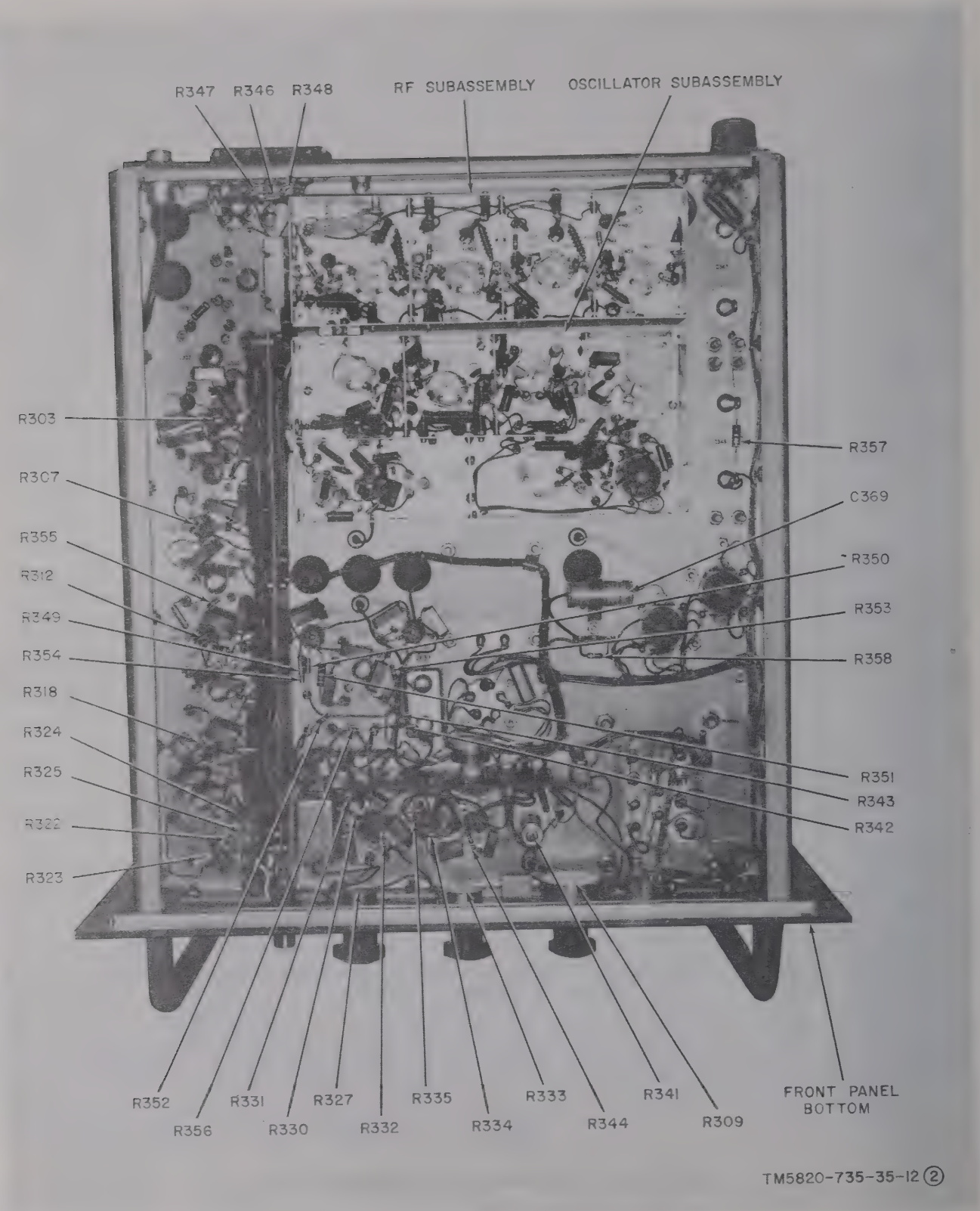


Figure 3-8(2). Parts location bottom view (part 2 of 3).

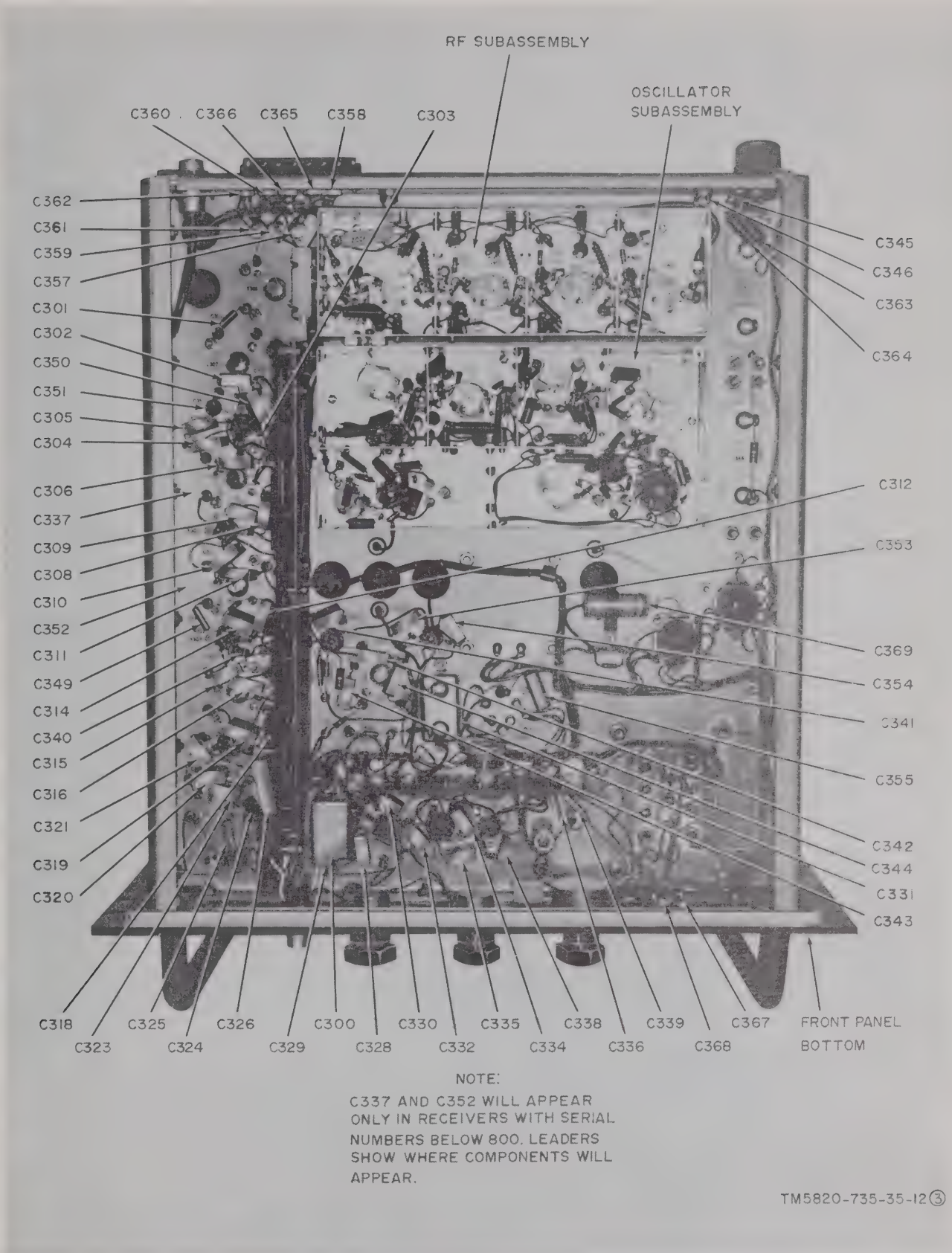


Figure 3-8(3). Parts location, bottom view (part 3 of 3).

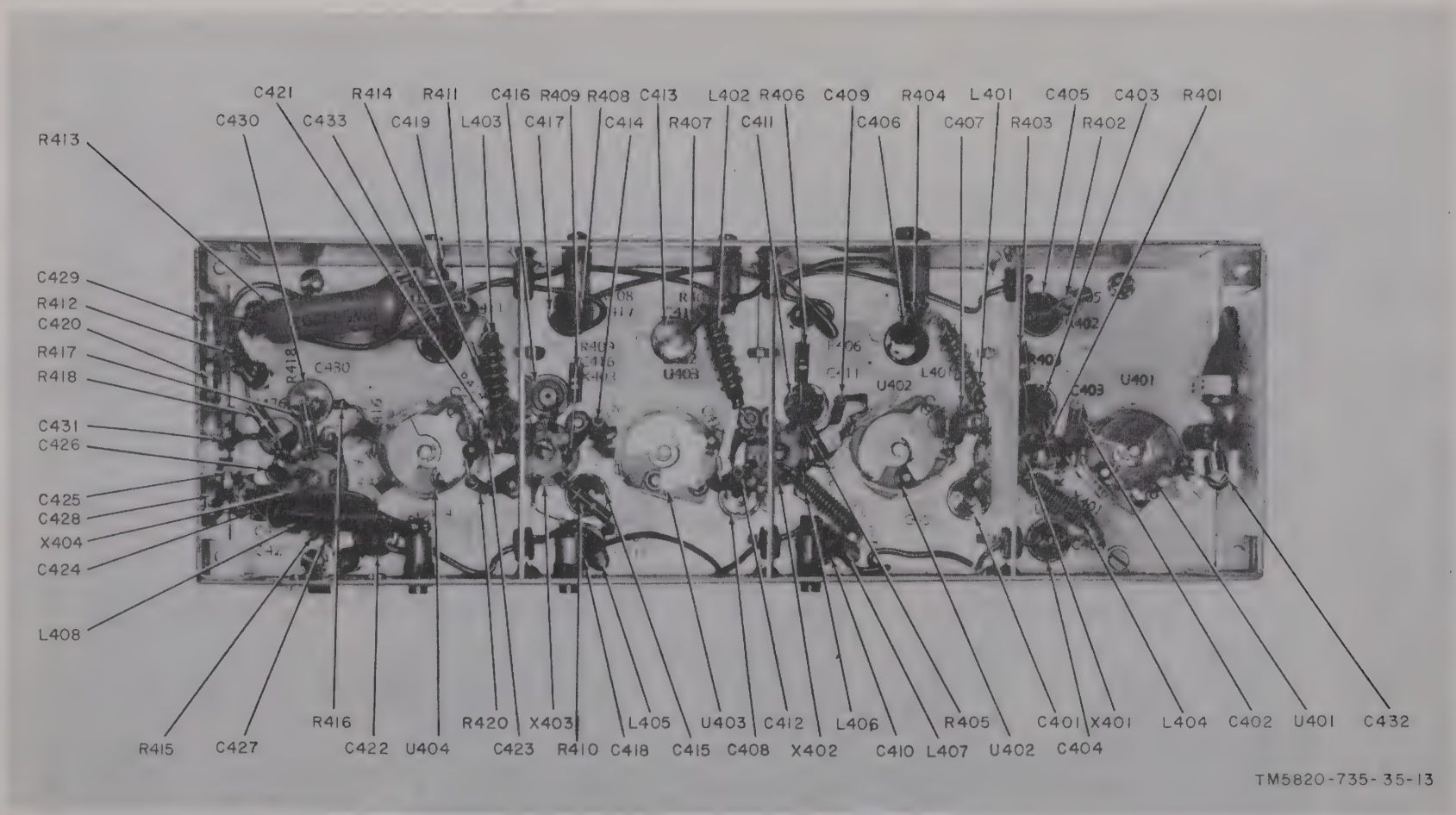


Figure 3–9. Parts location, RF. subassembly, bottom view, shield removed.

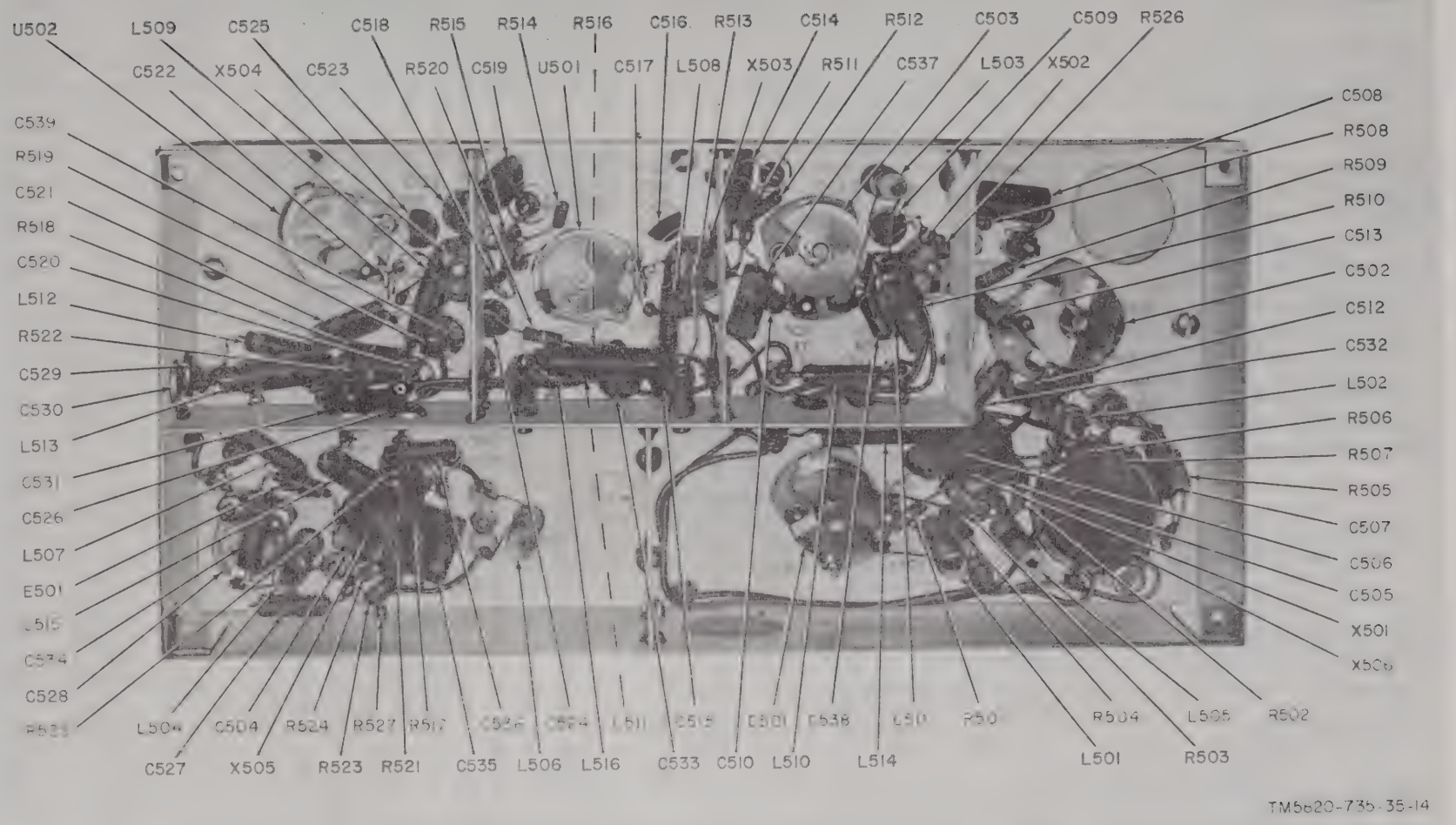
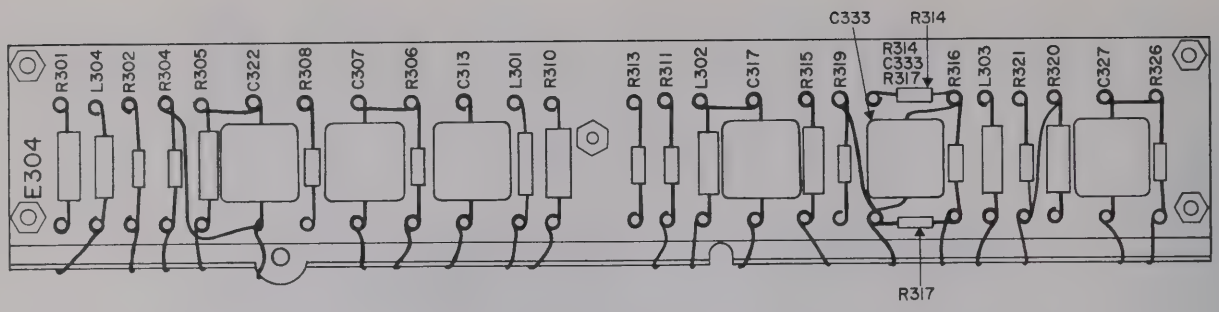
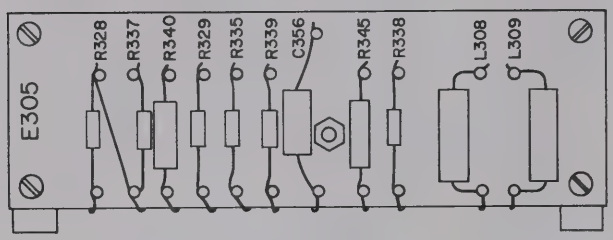


Figure 3–10. Parts location, oscillator subassembly, bottom view, shield removed.



TERMINAL BOARD E304



TERMINAL BOARD E305

TM5820-735-35-15

Figure 3-11. Parts location, terminal boards E304 and E305.

Section V. DIIRECT SUPPORT TESTING PROCEDURES

3-26. General

a. The testing procedures provided in this section are prepared for use by personnel responsible for direct support category maintenance to determine the acceptability of repaired equipment. The procedures set forth specific requirements that a repaired receiver must meet before it is returned to the using organization. Performance of certain of the procedures will also, at times, aid in sectionalizing the cause of defective operation. A summary of the performance standards is provided in paragraph 3-35.

b. Each test depends on the preceding one for certain operating procedures and, where applicable, for test equipment calibrations. Comply with the instructions preceding the body of each chart before proceeding to the chart. Perform each test in sequence. For each step, perform actions required in the *test equipment control setting* and *equipment under test control setting* columns; then perform each specific test procedure and verify it against its performance standard.

3–27. Physical Test and Inspection

a. Test Equipment and Materials. None.

b. Test Connections and Conditions. Remove receiver dust cover (para 3–19).

c. Test Procedure.

Step No.	Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None	Controls may be in any position	*a.* Inspect all controls and mechanical assemblies for evidence of physical damage and loose or missing parts.	*a.* Equipment should be complete and undamaged. All screws should be properly tightened.
			b. Check the front panel switches and controls for proper operation.	*b.* Switches should operate positively without binding. Controls should operate smoothly throughout their limits of travel.
			c. Inspect the rear panel connectors and terminal strip for evidence of damage or excessive wear.	*c.* The rear panel connectors and terminal strip should be free of damage and excessive wear.
			d. Remove front panel fuses and check for proper size and rating.	*d.* Fuse size and rating should be in accordance with front panel marking.
			e. Inspect all metal surfaces for condition of finish and panel markings. *Note.* Touchup painting is recommended in lieu of refinishing whenever practicable.	*e.* Metal surfaces intended to be painted should not show bare metal. All panel markings are legible.
			f. Inspect tuning capacitors to verify that rotor and stator plates do not touch for any capacitor setting.	*f.* Rotor and stator plates are not shorted.
			g. Inspect tuning units U401 through U404, U501 and U502 to verify that rotor plates are not shorted to the one-turn silver-plated inductance strap.	*g.* Rotor plates and inductance straps do not touch.
			h. Connect receiver power cord to ac power source.	*h.* None.
			i. Set receiver POWER switch to ON and verify that PILOT LIGHT illuminates and all tube filaments glow.	*i.* PILOT LIGHT illuminates and all tube filaments glow.
			j. Set receiver POWER switch to OFF.	*j.* Pilot light and tube filaments extinguish.
			k. Disconnect power cord from power source and receiver.	*k.* None.
			l. Replace receiver dust cover (para 3–19).	*l.* Dust cover fits securely in place.

3–28. Sensitivity Test

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Counter, Electronic Digital Readout AN/USM–207.
(3) Generator, Signal AN/USM–44A.
(4) Meter, Audio Level ME–356/U.
(5) Multimeter TS–352B/U.
(6) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as shown in figure 3–12. Allow test equipment and equipment under test approximately 30 minutes warmup time prior to use. If required, refer to applicable technical manuals (app. A) to verify that test equipment is properly calibrated.

c. Test Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*CN–16(*)/U* OFF–ON: ON Dial: 115. *TS–352B/U* FUNCTION: AC VOLTS Range: Any position OHMS ZERO ADJ: Any position *AN/USM–44A* FREQUENCY RANGE: E FREQUENCY control: to receiver frequency. FINE FREQ ADJUST: to index marker. MOD SELECTOR: CW MOD LEVEL: Fully counterclockwise. ATTEN: 3 MICROVOLTS 1 MC–OFF–5 MC: OFF XTAL CAL GAIN: Fully counterclockwise. OUTPUT LEVEL: 75% of full clockwise rotation. AMP TRIMMER: Any position. Power: ON *ME–356/U* IMPEDANCE switch to 60 on x10 scale.	RF GAIN: Fully clockwise. SQUELCH Switch: ON NOISE LIMITER (S303, top of chassis): ON. AUDIO QUIETING DB: Fully counterclockwise. A.F. GAIN: Full clockwise. POWER: ON.	*a.* Insert TS–352B/U test leads into unused receptacle of three-way plug and adjust CN–16(*)/U dial until TS–352B/U meter indicates 115 volts. *b.* Remove TS–352B/U test leads from the three-way plug. *c.* Prepare AN/USM–44A for operation using the following procedure: (1) Adjust AMP. TRIMMER control for maximum indication on the OUTPUT VOLTS meter. (2) Adjust OUTPUT LEVEL control until OUTPUT VOLTS meter indicates SET LEVEL. (3) Operate MOD SELECTOR switch to 1,000∿. (4) Rotate MOD LEVEL control clockwise until PERCENT MODULATION meter indicates 30%. (5) Connect output of AN/USM–44A to input of AN/USM–207. (6) Verify that frequency count displayed by the AN/USM–	*a.* TS–352B/U indicates 115V. *b.* None. *c.* None.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
	O–DB RANGE switch depressed. *Note.* Remaining controls may be in any position.		207 is equal to the receiver channel center frequency. (7) Disconnect the AN/USM–44A from the AN/USM–207 and reconnect to ANT. INPUT jack J401 on the receiver. *d.* Carefully adjust AN/USM–44A FINE FREQ. ADJUST control for a maximum indication on the ME–356/U. *e.* Operate receiver SQUELCH switch to OFF. *f.* Adjust receiver A.F. GAIN control until the ME–356/U indicates +10 dbm. *g.* Operate AN/USM–44A MOD SELECTOR switch to CW and note the ME–356/U meter indication.	*d.* ME–356/U reads minimum of +10 dbm. *e.* None. *f.* ME–356/U reads +10 dbm. *g.* ME–356/U should read a maximum of 0 dbm.

3–29. Squelch Threshold

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Cord CD–605 (used with HS–30–U).
(3) Counter, Electronic Digital Readout AN/USM–207.
(4) GENERATOR, SIGNAL AN/USM–44A.
(5) HEADSET HS–30–U or equivalent.
(6) Multimeter TS–352B/U.
(7) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as shown in figure 3–13. Allow test equipment and equipment under test approximately 30 minutes warmup time prior to performance of test.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	Same as for sensitivity test (para 3–28) except ME–356/U is not connected to the receiver, and set AN/USM–44A ATTEN to full counterclockwise position.	Same as for sensitivity test (para 3–28).	*a.* Same as for step 1*a*, *b*, and *c* (1) through (7) of sensitivity test (para 3–28). *b.* Monitor output of receiver through headset. The squelch should be operating to quiet the output of	*a.* Same as step 1*a*, *b*, and *c* (para 3–28). *b.* Output of receiver is quiet.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			the receiver. If this is not occurring, slowly rotate the RF GAIN control counterclockwise until the output of the receiver is quiet, indicating that the squelch has operated.	
			c. Slowly increase the output level of the AN/USM–44A until sound "pops" into the headset indicating that the squelch has deactivated. This is the squelch threshold point.	*c.* Output level of AN/USM–44A must be a maximum of 1.5 microvolt.
			d. Slowly decrease the output level of the AN/USM–44A until the output of the receiver is again quite. Note the output voltage of the AN/USM–44A.	*d.* AN/USM–44A output voltage should be approximately 2/3 of that in *c* above.

3–30. Avc Threshold and Level Control

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Counter, Electronic Digital Readout AN/USM–207.
(3) Generator, Signal AN/USM–44A.
(4) Meter, Audio Level ME–356/U.
(5) Multimeter, TS–352B/U.
(6) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as illustrated in figure 3–12. Allow test equipment and equipment under test approximately 30 minutes warmup time prior to performance of any tests.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	Same as for sensitivity test (para 3–28) except depress +20 RANGE switch on ME–356/U.	Same as for sensitivity test (para 3–28).	*a.* Same as for step 1*a*, *b*, and *c*(1) through (7) of sensitivity test (para 3–28).	*a.* Same as step 1*a*, *b*, and *c*, (para 3–28).
			b. Slowly increase output of AN/USM–44A until output registered on ME–356/U no longer increases in direct proportion to the input. This is the avc threshold point.	*b.* Output of AN/USM–44A must not exceed 6 microvolts.
			c. Set output of AN/USM–44A to 50 microvolts.	*c.* None.
			d. Depress +10 RANGE switch on ME–356/U.	*d.* None.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			e. Set A.F. GAIN control as required to obtain receiver output of 50 milliwatts (17 dbm).	*e.* ME–356/U reads +7 dbm.
			f. Sequentially set output level of AN/USM–44A to 5, 7.5, 500, 5,000, and 50,000 microvolts. Read ME–356/U reading for each setting.	*f.* ME–356/U reading must not vary more than 5 db throughout range.

3–31. Maximum Power Output

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Counter, Electronic Digital Readout AN/USM–207.
(3) Generator, Signal AN/USM–44A.
(4) Meter, Audio Level ME–356/U.
(5) Multimeter TS–352B/U.
(6) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as illustrated in figure 3–12.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	Same as for sensitivity test (para 3–28) except depress +20 RANGE switch on ME–356/U.	Same as for sensitivity test (para 3–28).	*a.* Same as for step 1*a*, *b*, and *c*(1) through (7) of sensitivity test (para 3–28).	*a.* Same as for step 1*a*, *b*, and *c* (para 3–28).
			b. Increase output from AN/USM–44A until ME–356/U no longer registers increase in output level.	*b.* ME–356/U must register a minimum of +10 dbm for input of 50 microvolts.

3–32. Selectivity and Image Rejection Tests

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Counter, Electronic, Digital Readout AN/USM–207.
(3) Generator, Signal AN/USM–44A.
(4) Meter, Audio Level ME–356/U.
(5) Multimeter, TS–352B/U.
(6) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as shown in figure 3–12. Allow test equipment and equipment under test approximately 30 minutes warmup time prior to performance of any tests. If necessary, refer to applicable technical manuals (app. A) to verify that test equipment is properly calibrated, and obtain detailed instructions for use.

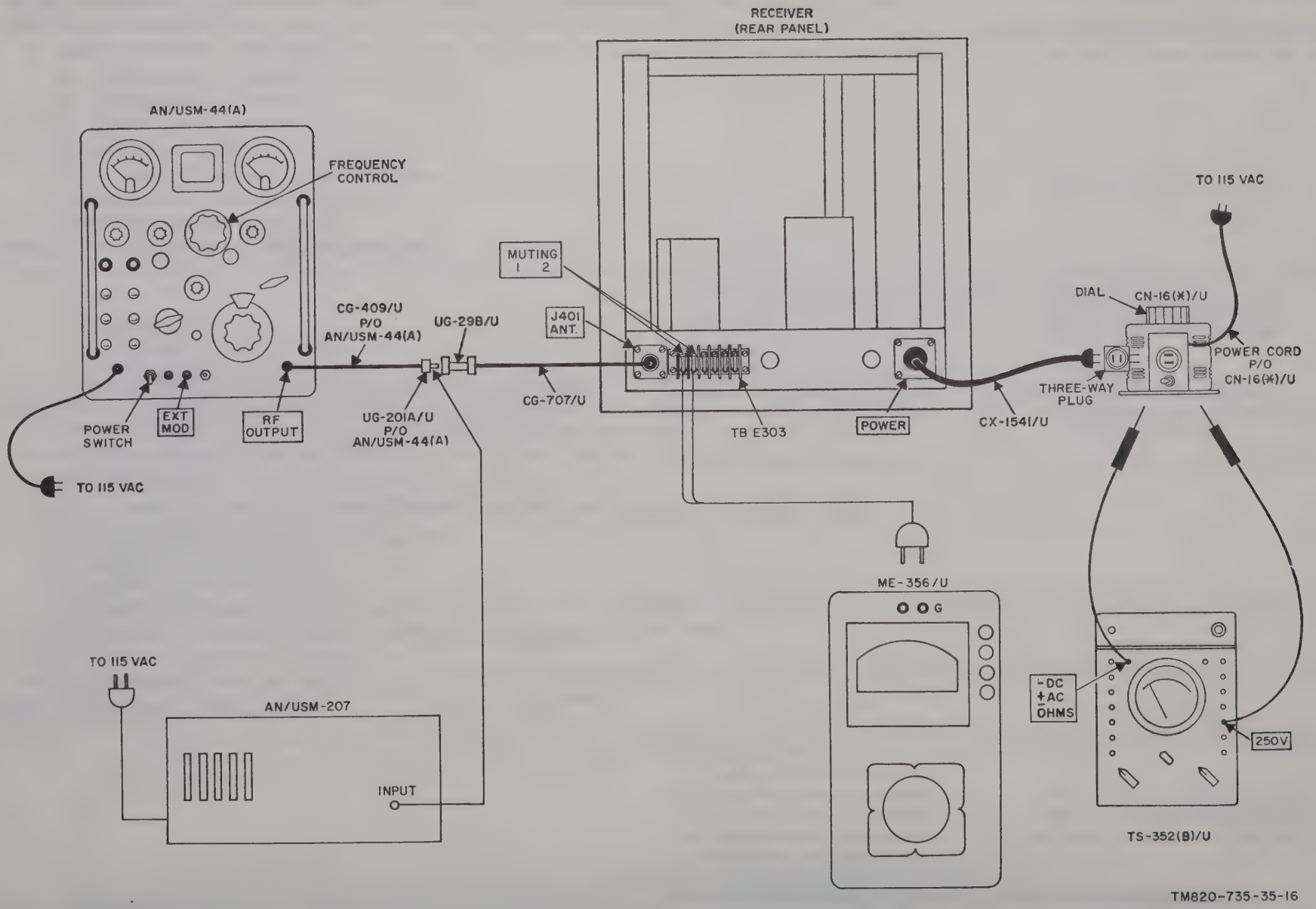


Figure 3–12. Sensitivity, selectivity, avc threshold, and power output test setup.

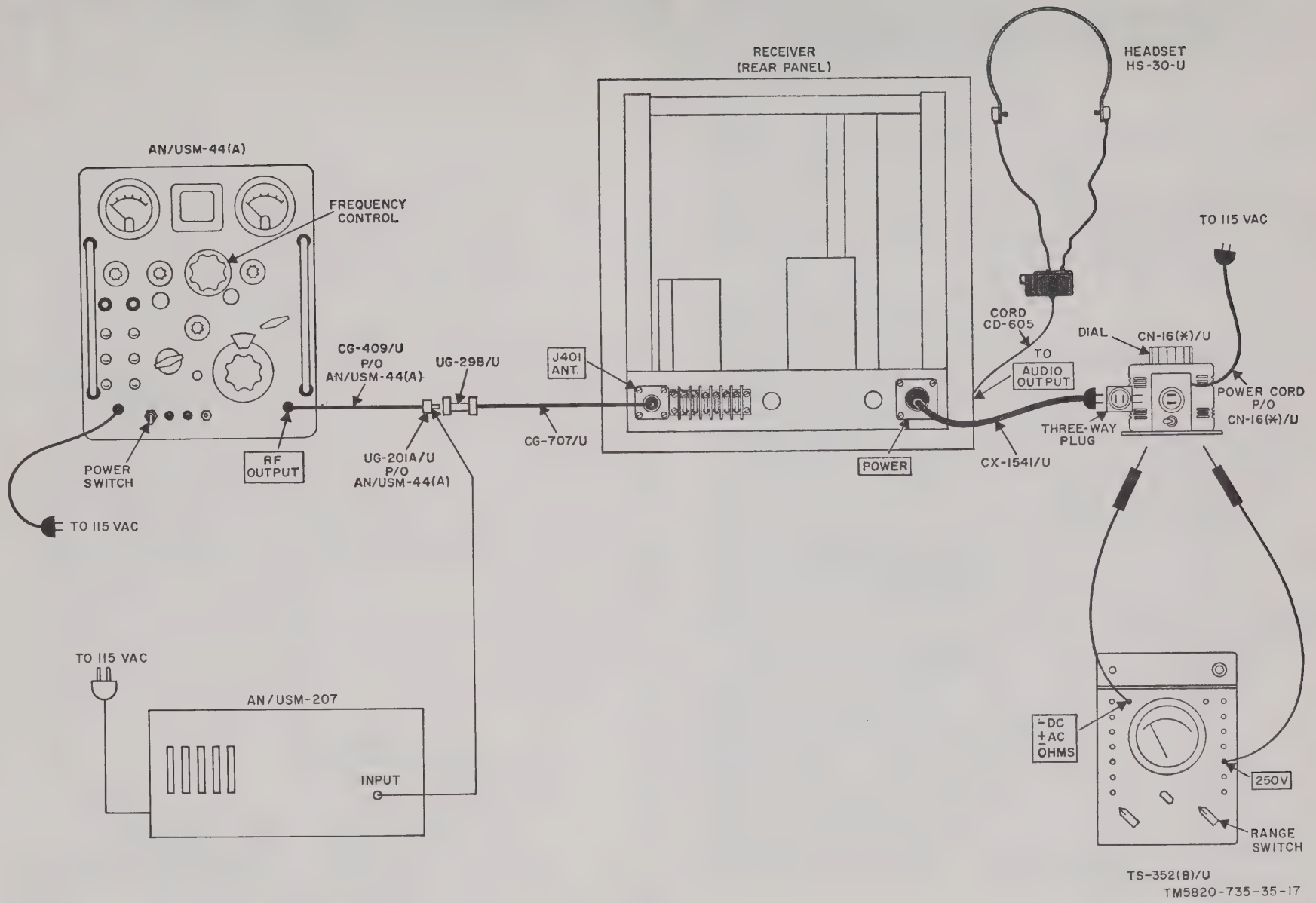


Figure 3–13. Squelch threshold test setup.

c. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	Same as for sensitivity test except depress +10 RANGE switch on ME–356/U.	RF GAIN: Fully clockwise. SQUELCH: OFF NOISE LIMITED: ON AUDIO QUIETING DB: Fully counterclockwise. AF GAIN: Midposition POWER: ON	*a.* Insert TS–352B/U test leads into unused receptacles of the three-way plug and adjust CN–16(*)/U dial until TS–352B/U indicates 115 volts.	*a.* None.
			b. Remove TS–352B/U test leads from the three-way plug.	*b.* None.
			c. Prepare AN/USM–44A for operation using the following procedure: (1) Adjust AMP TRIMMER control for maximum indication on the OUTPUT VOLTS meter. (2) Adjust OUTPUT LEVEL control until OUPUT VOLTS meter indicates SET LEVEL. (3) Operate MOD SELECTOR switch to 1,000∿. (4) Rotate MOD LEVEL control clockwise until PERCENT MODULATION meter indicates 30%.	*c.* None
	AN/USM–207 POWER: ON RANGE: 225–500 MC		*d.* Carefully adjust AN/USM–44A frequency control for maximum indication on the ME–356/U.	*d.* None.
			e. Adjust receiver AF GAIN control until the ME–356/U indicates 0 on the DECIBELS scale.	*e.* ME–356/U reads 0 DB.
			f. Set AN/USM–44A ATTEN control to 6 MICROVOLTS.	*f.* None.
			g. Rotate AN/USM–44A frequency control clockwise until the ME–356/U again indicates 0 on the DECIBELS scale.	*g.* ME–356/U reads 0 DB
			h. Remove AN/USM–44A RF OUTPUT cable from connector adapter UG–201A/U and connect to AN/USM–207.	*h.* None.
			i. Measure and record the frequency of the AN/USM–44A.	*i.* None.
			j. Remove AN/USM–44A RF OUTPUT cable from the AN/USM–207 and reconnect it to Connector Adapter UG–201A/U.	*j.* None

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			k. Rotate AN/USM–44A FREQENCY control counterclockwise until the ME–356/U meter again indicates 0 on the DECIBELS scale.	*k.* ME–356/U reads 0 DB.
			l. Repeat *h* and *i* above.	*l.* None.
			m. Substract the frequency recorded in *l* above from that in *i* above.	*m.* For receivers with serial numbers below 800: Not less than 80 kHz. For serial numbers 800 or above: Not less than 58 kHz.
			n. Repeat *j* above.	*n.* None.
2	As last indicated except: *AN/USM–44A* ATTEN: 3 MILLIVOLTS	As last indicated	*a.* Rotate AN/USM–44A frequency control counterclockwise until ME–356/U again indicates 0 on the DECIBELS scale.	*a.* ME–356/U reads 0 DB.
			b. Repeat steps 1*h* and 1*i* above.	*b.* None.
			c. Repeat step 1*j* above.	*c.* None.
			d. Repeat step 1*g* above.	*d.* None.
			e. Repeat steps 1*h* and 1*i* above.	*e.* None.
			f. Subtract the frequency recorded in *b* above from that recorded in *e* above.	*f.* For receivers having serial numbers below 800: Not more than 236 kHz. For serial numbers 800 or above: Not more than 180 kHz.
3	Same as last indicated	Same as last indicated	*a.* Remove AN/USM–44A RF OUTPUT cable from connector adapter UG–201A/U and connect to input of AN/USM–207.	*a.* None.
			b. Adjust output frequency of AN/USM–44A to center frequency of receiver minus 80.8 MHz (2 x the first IF).	*b.* AN/USM–207 reads center frequency of receiver minus 80.8 MHz.
			c. Disconnect the AN/USM–44A RF cable from the AN/USM–207 and reconnect to connector adapter UG–201A/U.	*c.* None.
			d. Rotate AN/USM–44A ATTEN control to obtain indication of 0 DB on ME–356/U.	*d.* ME–356/U must read 0 DB.
			e. Note output voltage from AN/USM–44A.	*e.* Output voltage must be a minimum of 3 millivolts.

d. Calculation of Nonsymmetry at 60=Db Points.

(1) Calculate the percentage of nonsymmetry at the 60-db points using the following equation:

$$\% \text{ of nonsymmetry} = \left(\frac{\triangle f_1}{\triangle f_2} - 1 \right) \times 100.$$

$\triangle f_1$ = Difference between receiver channel frequency and frequency below channel frequency at which 60-db attenuation occurs (*c2b* above).

$\triangle f_2$ = Difference between receiver channel frequency and frequency above channel frequency at which 60-db attenuation occurs (*c2c* above).

Note. If $\triangle f_2$ is larger than $\triangle f_1$, use $-\% \text{ of nonsymmetry} = \left(\frac{\triangle f_2}{\triangle f_1} - 1 \right) \times 100.$

(2) The calculated percent of nonsymmetry must not exceed 15 percent.

3–33. Audio Frequency Response Test

a. Test Equipment and Materials.

(1) Adapter, Connector UG–29B/U.
(2) Counter, Electronic Digital Readout AN/USM–207.
(3) Generator, Signal AN/USM–44A
(4) Meter, Audio Level ME–356/U.
(5) Multimeter TS–352B/U.
(6) Oscillator, Audio SG–19/U.
(7) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as shown in figure 3–14. Allow test equipment and equipment under test approximately 30 minutes warmup time before performance of test.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*CN–16(*)/U* OFF–ON: ON Dial: 115 *TS–352B/U* FUNCTION: AC VOLTS Range: Any position OHMS ZERO ADJ: Any position *AN/USM–44A* FREQUENCY RANGE: E FREQUENCY control: Set receiver frequency.	RF GAIN: Fully clockwise A. F. GAIN: Midposition SQUELCH: ON NOISE LIMITER: ON AUDIO QUIETING DB: Fully counterclockwise. POWER: ON	*a.* Insert TS–352B/U test leads into unused receptacles of the three-way plug and adjust CN–16(*)/U dial until TS–352B/U meter indicates 115 volts. *b.* Remove TS–352B/U test leads from the three-way plug. *c.* Prepare AN/USM–44A for operation using the following procedure: (1) Adjust AMP TRIMMER control for maximum indica-	*a.* None. *b.* None. *c.* None.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
	FINE FREQ. ADJ: To index marker. MOD Selector: EXT MOD LEVEL: Fully counterclockwise. ATTEN: 5 MICROVOLTS XTAL CAL GAIN: Fully counterclockwise. 1 MC–OFF–5 MC: OFF OUTPUT LEVEL: 75% of full clockwise rotation. AMP TRIMMER: Any position. Power: ON *SG–19/U* POWER: ON RANGE: x10 FREQUENCY DIAL: 100 AMPLITUDE control: Fully counterclockwise. *ME–356/U* IMPEDANCE control: 60 on x10 scale. RANGE: Depress +20 switch.		tion on the OUTPUT VOLTS meter. (2) Adjust OUTPUT LEVEL control until OUPUT VOLTS meter indicates SET LEVEL. (3) Temporarily connect output of AN/USM–44A to input of AN/USM–207. (4) Verify that frequency count displayed on AN/USM–207 is the receiver channel frequency. (5) Reconnect output of AN/USM–44A to ANT. INPUT jack on receiver. (6) Adjust AMPLITUDE control on SG–19/U and MOD LEVEL control on AN/USM–44A to obtain reading of 30% on PERCENT MODULATION meter on AN/USM–44A.	
			d. Set AN/USM–44A ATTEN control to 100 microvolts.	*d.* None.
			e. Adjust receiver A.F. GAIN control as required to obtain reading of +10 DB on ME–356/U.	*e.* ME–356/U reads +10 db.
			f. Slowly sweep the output frequency of the SG–19/U through the range of 400 to 3,000 Hz, verifying that PERCENT MODULATION meter on AN/USM–44A remains at 30%. Note reading on ME–356/U throughout the sweep.	*f.* Reading on ME–356/U must not decrease below +5 db.
			g. Set output frequency of SG–19/U to 100 Hz and verify that PERCENT MODULATION meter on AN/USM–44A remains at 30%.	*g.* None.
			h. Note reading on ME–356/U.	*h.* Reading on ME–356/U must not exceed 0 DB.
			i. Set output frequency of SG–19/U to 6,000 Hz. Verify that PERCENT MODULATION meter on AN/USM–44A reads 30.	*i.* Reading on ME–356/U must not exceed 0 DB.

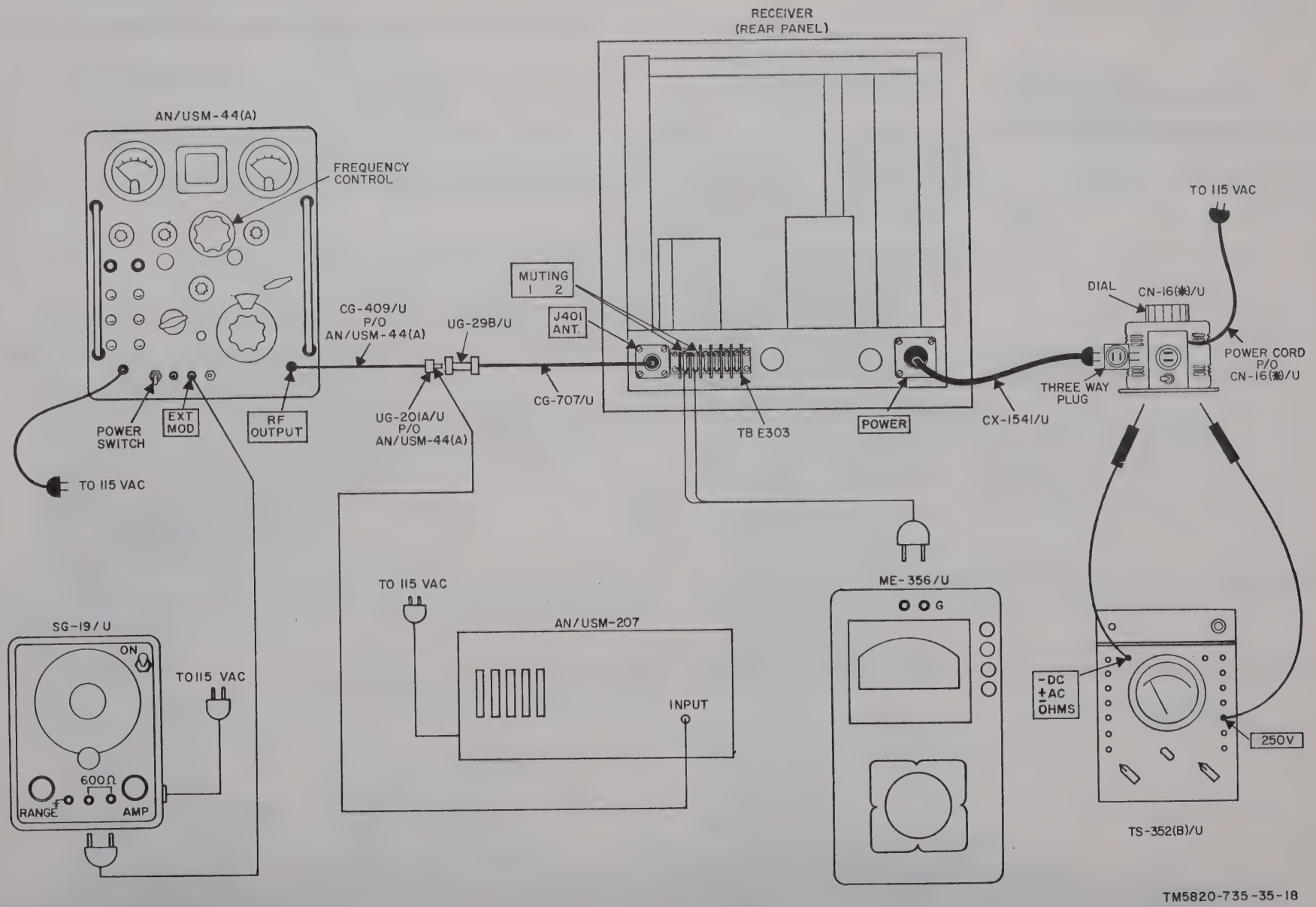


Figure 3-14. Audio frequency response test setup.

3–34. First and Second Oscillator Frequency Test

a. Test Equipment and Materials.

(1) Counter, Electronic Digital Readout AN/USM–207.
(2) Meter, Audio Level ME–356/U.
(3) Multimeter TS–352B/U.
(4) Transformer, Variable CN–16(*)/U.

b. Test Connections and Conditions. Connect equipment as illustrated in figure 3–15. Allow test equipment and equipment under test 30 minutes warmup time before performance of any tests.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*AN/USM–207* POWER switch: ON Remaining controls set as necessary to monitor low level 100 MHz frequency. *TS–352B/U* FUNCTION: AC VOLTS Range: Any position OHMS ZERO ADJUST: Any position. *CN–16(*)/U* OFF–ON: ON Dial: 115 *ME–356/U* IMPEDANCE control: 60 on x10 range. RANGE: +10 switch depressed.	RF GAIN: Fully counterclockwise. A.F. GAIN: Midposition SQUELCH: ON NOISE LIMITER (S303, top of chassis): ON AUDIO QUIETING DB: Fully counterclockwise. POWER: ON	*a.* Insert TS–352B/U test leads into unused receptacles of the three-way plug and adjust CN–16(*)/U dial until TS–352B/U meter indicates 115 volts. *b.* Remove TS–352B/U test leads from the three-way plug. *c.* With AN/USM–207 connected to pin 2 of V404 as illustrated in figure 3–15, note and record frequency count displayed on AN/USM–207. *d.* Set receiver POWER switch to OFF. *e.* Connect AN/USM–207 to pin 1 of V301 as illustrated in figure 3–15. *f.* Note and record frequency count displayed by AN/USM–207.	*a.* None. *b.* None. *c.* Frequency count displayed on AN/USM–207 must equal the receiver channel frequency minus 40.4 MHz ±10 kHz. *d.* None. *e.* None. *f.* Frequency count displayed on AN/USM–207 must be 34.4 MHz ±10 kHz.

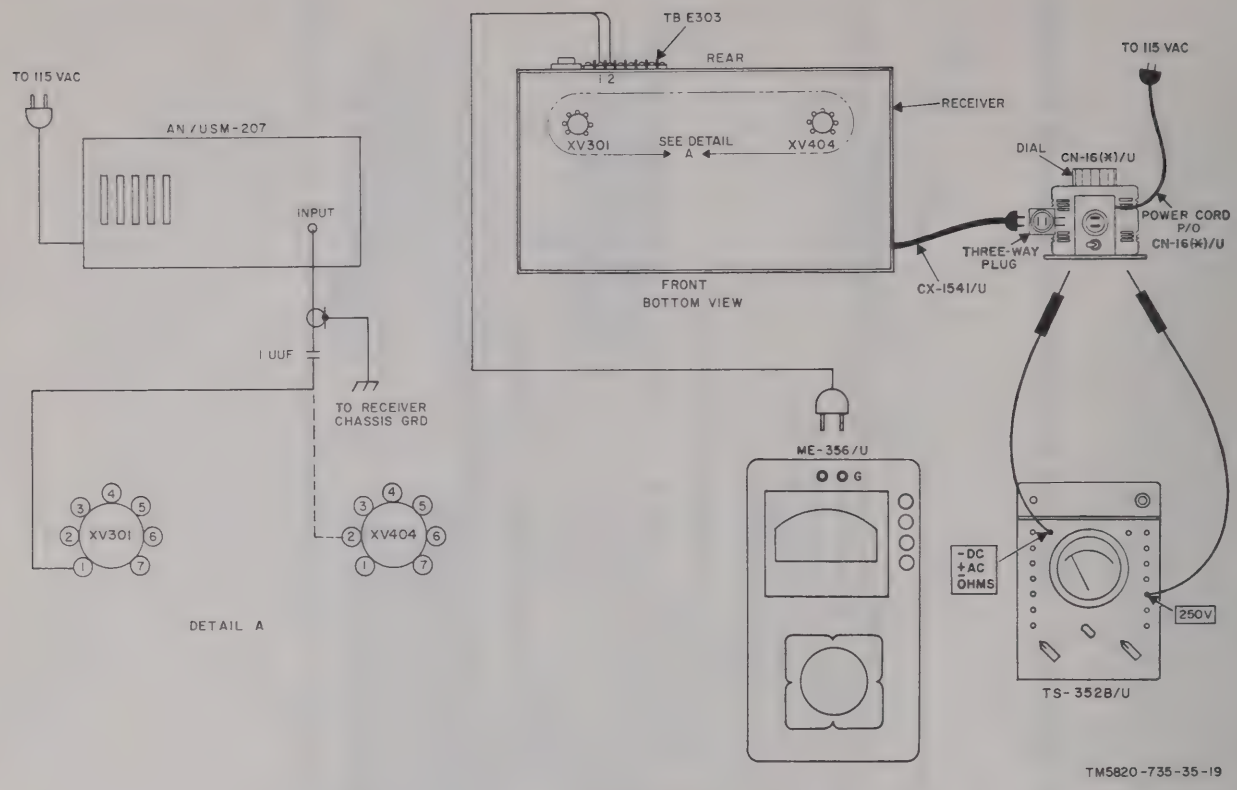


Figure 3–15. Typical oscillator frequency test setup.

3–35. Summary of Performance Standards

a. Sensitivity	3 microvolts for 10 milliwatt output with 10:1 Signal + Noise to Noise ratio.	
b. Squelch Threshold	1.5 microvolt maximum.	
c. Avc Threshold and Level Control	Threshold = 6 microvolts maximum. Receiver output must not vary more than 5 db for an input of 5 to 50,000 microvolts.	
d. Maximum Power Output	1 watt for 50-microvolt input modulated 30% for all frequencies from 400 to 3,000 Hz.	
e. Selectivity	Receivers with serial numbers below 800:	Receivers with serial numbers 800 and above:
6 DB	80 kHz minimum	58 kHz minimum
60 DB	236 kHz maximum	180 kHz maximum
f. Image Rejection	Better than 60 DB.	
g. Nonsymmetry at 60-DB Points	15 percent maximum.	
h. Audio Frequency Response	Flat within 5 DB from 400 to 3,000 Hz. Down minimum of 10 DB below 200 and above 5,000 kHz.	
i. First and Second Oscillator Frequency	First oscillator injection frequency equal to receiver channel frequency minus 40.4 MHz ±10 kHz. Second oscillator frequency 34.4 MHz ±10 kHz.	

CHAPTER 4

GENERAL SUPPORT AND DEPOT MAINTENANCE

General support and depot category maintenance is indicated to that authorized at the direct support category since no additional tools, test equipment, or spare parts are authorized at the general support or depot category by the maintenance support plan. In addition, no additional testing is required at the general support category by the maintenance support plan. Depot overhaul standards are furnished in chapter 5.

CHAPTER 5

DEPOT OVERHAUL STANDARDS

5–1. Scope and Applicability of Depot Overhaul Standards

Alignment and testing procedures are given in chapter 3 since no additional test equipment is allocated to this level of maintenance. The tests outlined in section V of chapter 3 are designed to measure the performance of a repaired receiver and differ from overhaul standards only in tolerance requirements listed in paragraph 5–4. Equipment that meets the minimum standards outlined in paragraph 5–4 will furnish satisfactory operation, equivalent to that of new equipment.

5–2. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355–1, TB SIG 355–2, and TB SIG 355–3 form a part of the requirements for testing this equipment.

b. Technical Publications. The following technical publications are applicable to this equipment: TM 11–5820–735–12, TM 11–5820–201–12P, and TM 11–5820–201–35P. For titles, see appendix A.

c. Modification Work Orders. Perform all applicable modification work orders pertaining to this equipment before making the tests specified. DA Pam 310–7 lists all available modification work orders.

5–3. General Test Requirements

All tests should be conducted under the conditions specified in chapter 3.

a. Tests should be made after a warmup period of 1 hour.

b. Power input should be 120 volts ±5, single phase, 60 Hz, or 230 volts ±5, single phase, 60 Hz as determined by connections at transformer T307.

5–4. Specific Tests

a. Receiver Sensitivity (para 3–28). Measure and record the receiver sensitivity in microvolts. Performance standards are as specified in the sensitivity test outlined in paragraph 3–28*c*.

b. Receiver Squelch Threshold (para 3–29*c*). Measure and record the receiver squelch threshold in microvolts. Performance standards are as specified in the squelch threshold test outlined in paragraph 3–29*c*.

c. Avc Threshold and Level Control (para 3–30). Measure and record receiver avc threshold in microvolts and output deviation in dbm. Performance standards must be as specified below.

Step	Performance standard
1*d*	Output of AN/USM–44A must be 5 microvolts or less.
1*h*	The levels registered on the ME–356/U must not vary more than 4 dbm throughout the settings.

d. Maximum Power Output (para 3–31). Measure and record the maximum audio output in dbm. Output must be a minimum of +30 dbm.

e. Selectivity, 6–Db Points (para 3–32*c*1). Measure and record AN/USM–44A frequency deviations in kilohertz. Performance standards must be as specified in the chart below.

Step	Performance standard
1*m*	For receivers with serial numbers below 800: Not less than 85 kHz. For serial numbers 800 or above: Not less than 60 kHz.

f. Selectivity, 60-Db Points (para 3–32*c*2). Measure and record AN/USM–44A frequency deviations in kilohertz. Performance standards must be as specified below.

Step	Performance standard
2*f*	For receivers with serial numbers below 800: Not more than 225 kHz. For serial numbers 800 and above: Not more than 175 kHz.

g. Image Rejection (para 3–32*c*3). Check image rejection of receiver at frequency 80.8 MHz below center frequency of receiver. Performance

standard is same as specified in step 3*e*, paragraph 3–32*c*.

h. Symmetry (para 3–32*d*). Calculate the percent of nonsymmetry. Performance standard is the same as that specified (percent of nonsymmetry must not exceed fifteen percent).

i. Audio Frequency Response (para 3–33). Perform the audio frequency response performance test outlined in paragraph 3–33. Performance standard is the same as that specified in step 1*f*, 1*h*, and 1*i*.

j. Oscillator Frequency. Perform the oscillator frequency performance test outlined in paragraph 3–34. Performance standards are the same as specified.

APPENDIX A

REFERENCES

The following publications contain information applicable to the maintenance of Receiver, Radio R-1547/FSQ-75(V).

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8 and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 9-213	Painting Instructions for Field Use.
TM 11-5551E	R.F. Signal Generator AN/URM-25F.
TM 11-5820-201-12P	Operator's and Organizational Maintenance Repair Parts and Special Tool List for Radio Receiving Set AN/GRR-7.
TM 11-5820-201-35P	Field and Depot Maintenance Repair Parts and Special Tool List for Radio Receiving Set AN/GRR-7.
TM 11-5820-735-12	Operation and Organizational Maintenance Manual, Receiver, Radio R-1547/FSQ-75(V).
TM 11-6625-200-12	Operator and Organizational Maintenance Manual, Meter, Volt ME-26( )/U.
TM 11-6625-274-12	Operation and Organizational Maintenance Manual, Test Sets, Electron Tube TV-7( )/U.
TM 11-6625-366-15	Multimeters TS-352B/U.
TM 11-6625-508-10	Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 11-6625-535-15	Organizational, DS, GS, and Depot Maintenance Manual: Oscilloscope AN/USM-140A.
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

ACSC-E (2)
CofSptS (1)
USAMB (10)
USACDCEC (10)
USACDCCEA (1)
USACDCCEA (Ft Huachuca) (1)
USAMC (2)
USMACV (50)
LOGCOMD (2) except
1st LOGCOMD (10)
9th LOGCOMD (10)
8th US Army (5)
LBAD (10)
SAAD (15)
TOAD (10)
LEAD (7)
AFF (Vietnam) (5)
USARV (10)
1st Cav Div (5)
USAINTS (3)
USATECOM (2)

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

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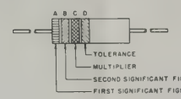
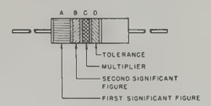
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

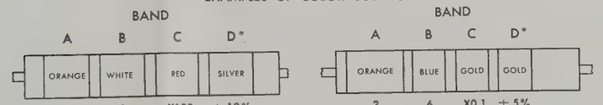


BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

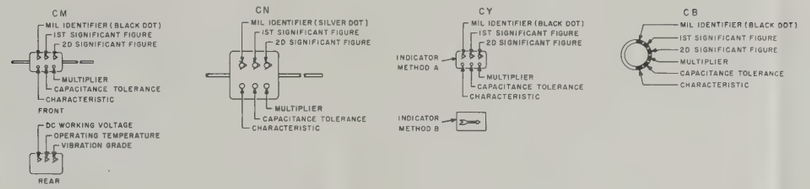
EXAMPLES OF COLOR CODING



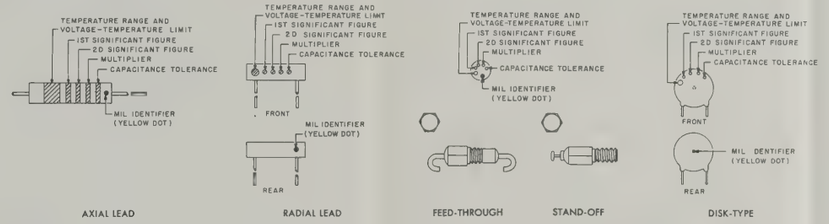
*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



GROUP III Capacitors, Fixed, Ceramic-Dielectric (Temperature Compensating) Style CC

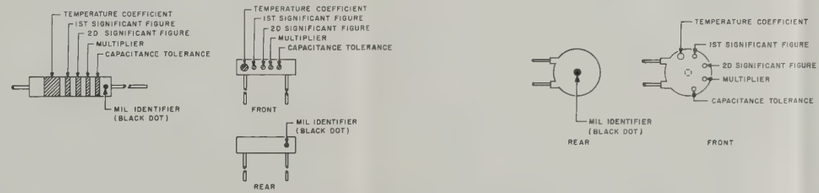


Figure 5-1. Color code marking for MIL STD capacitors and resistors.

COLOR CODE TABLES

TABLE I -- For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE CM	CN	CY	CB	CHARACTERISTIC[2] CM	CN	CY	CB	DC WORKING VOLTAGE CM	OPERATING TEMP RANGE CM	VIBRATION GRADE CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				55° to +70°C	10-55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			-55 to +85 C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					-55° to +125°C	10-2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											-55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	5%							
SILVER	CN				± 10%	± 10*	± 10%	10%							

TABLE II -- For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE - TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III -- For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE Capacitances over 10uuf	Capacitances 10uuf or less	MIL ID
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	30	1	1	10	± 1%		
RED	80	2	2	100	± 2%	± 0.25uuf	
ORANGE	150	3	3	1,000			
YELLOW	220	4	4				
GREEN	330	5	5		± 5%	± 0.5uuf	
BLUE	470	6	6				
PURPLE (VIOLET)	750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	± 100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL-C-5, MIL-C-91, MIL-C-11272 and MIL-C-10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL-C-11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD-C2

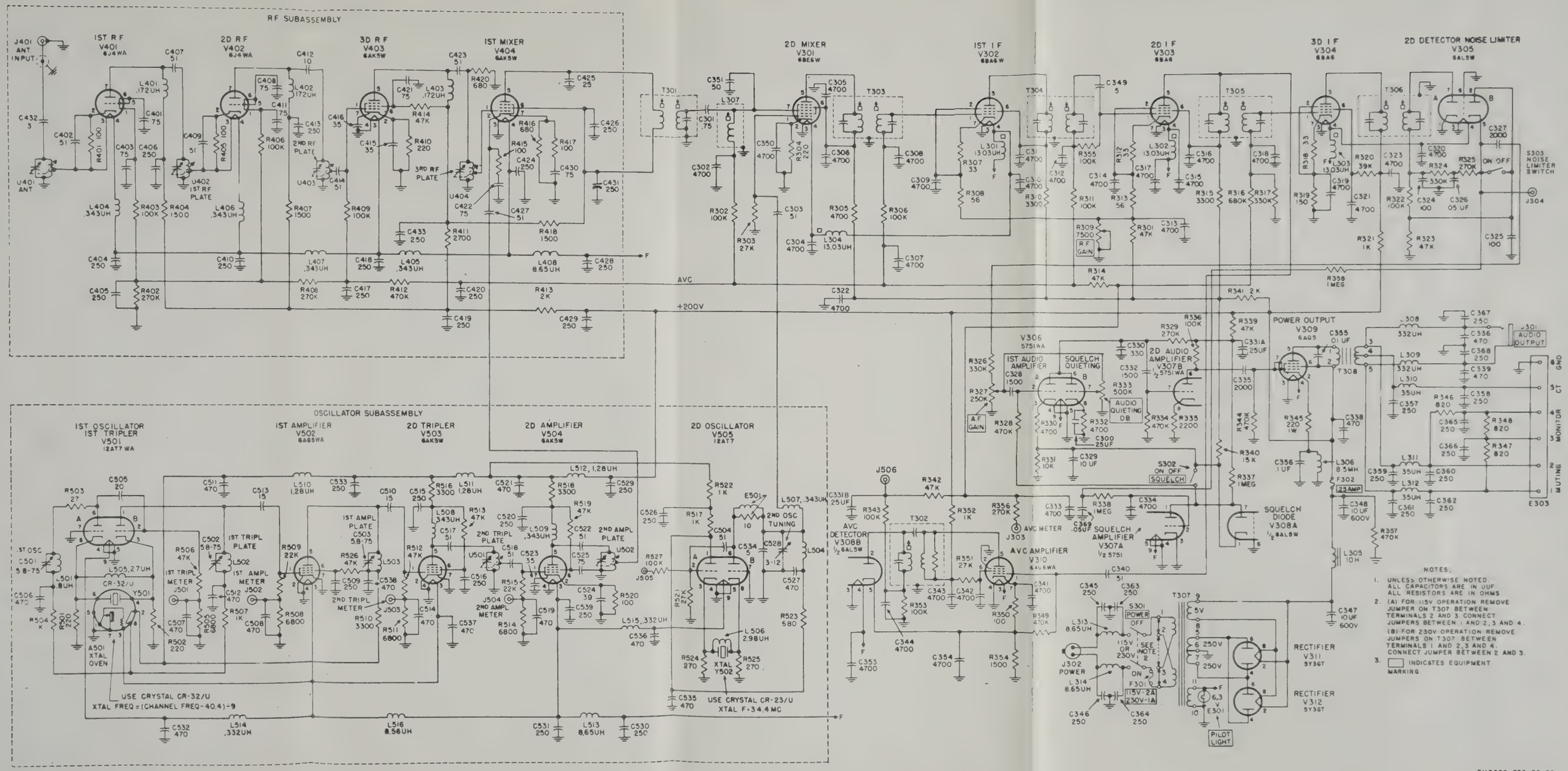


Figure 5–2. Receiver, Radio R–1547/FSQ–75(V), schematic diagram.

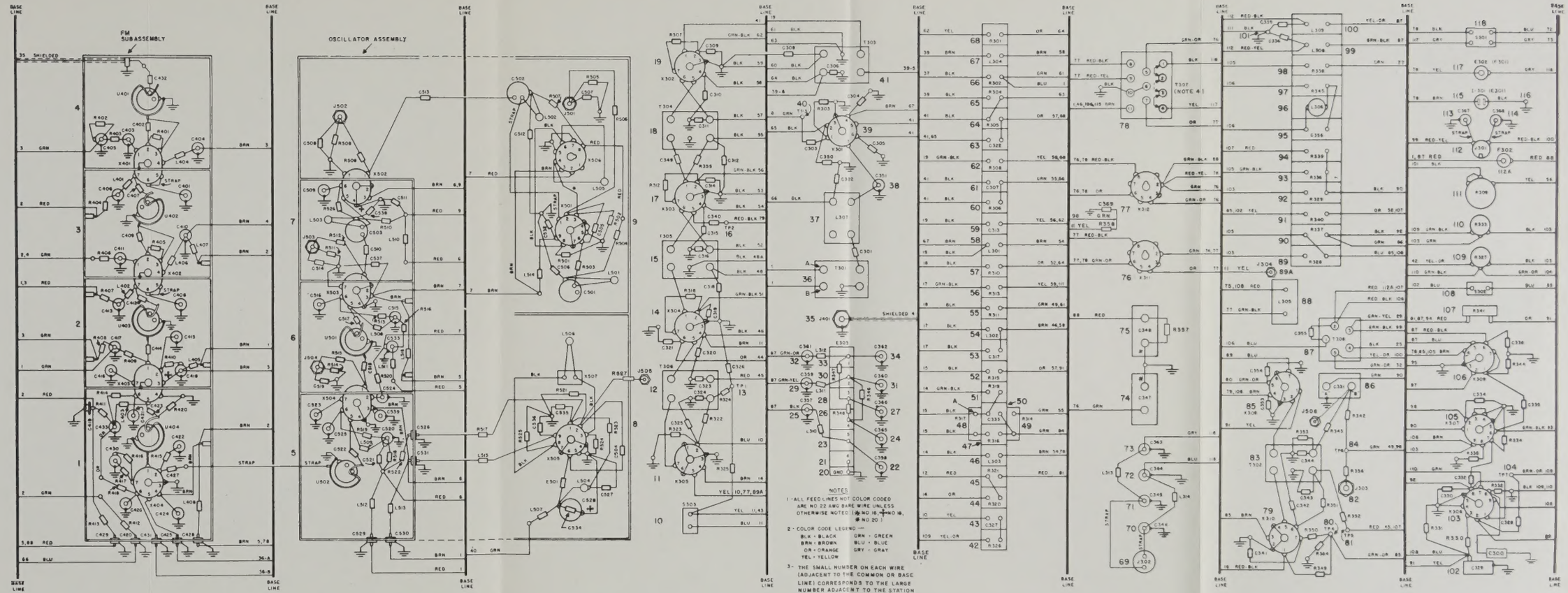


Figure 5-3. Receiver, Radio R-1547/FSQ-75(V), wiring diagram.